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INDEX TO EXECUTIVE DOCUMENTS OF HOUSE OF REPRESENTATIVES.

CONTENTS OF THE VOLUMES.

Vol. 1..FOREIGN RELATIONS: No. 1, pt. 1.
Vol. 2..WAR: No. 1, pt. 2, v. 1.
Vol. 3.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 1.
Vol. 4.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 2.
Vol. 5.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 3.
Vol. 6.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 4.
Vol. 7.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 5.
Vol. 8.. ENGINEERS: No. 1, pt. 2, v. 2, pt. 6.
Vol. 9.. ORDNANCE: No. 1, pt. 2, v. 3.
Vol. 10.. SIGNAL OFFICER: No. 1, pt. 2, v. 4.
Vol. 11.. INSPECTOR-GENERAL: No. 1, pt. 2, v. 5.
Vol. 12..NAVY: No. 1, pt. 3.
Vol. 13..POSTMASTER-GENERAL: No. 1, pt. 4.
Vol. 14..INTERIOR: No. 1, pt. 5, v. 1.
Vol. 15.. No. 1, pt. 5, v. 2.
Vol. 16.. No. 1, pt. 5, v. 3.
Vol. 17.. GEOLOGICAL SURVEY: No. 1, pt. 5, v. 4, pt. 1.
Vol. 18..INTERIOR: GEOLOGICAL SURVEY: No. 1, pt. 5, v. 4, pt. 2.
Vol. 19.. EDUCATION: No. 1, pt. 5, v. 5.
Vol. 20..AGRICULTURE: No. 1, pt. 6.
Vol. 21..DISTRICT OF COLUMBIA: No. 1, pt. 7.
Vol. 22..No. 1, pt. 8, and Nos. 4 and 7.
Vol. 23..No. 2, FINANCE REPORT.
Vol. 24..No. 3, part 1.
Vol. 25..No. 3, part 2.
Vol. 26..Nos. 5, 94, and 205.
Vol. 27..No. 6, part 1.
Vol. 28..No. 6, part 2.
Vol. 29..Nos. 8 to 28, inclusive.
Vol. 30..Nos. 29 to 46, inclusive, except No. 43.
Vol. 31..No. 43, part 1.
Vol. 32..No. 43, part 2.
Vol. 33..Nos. 47 to 79, inclusive.
Vol. 34..Nos. 80 to 135, inclusive, except No. 94.
Vol. 35..Nos. 136 to 200, inclusive, except No. 161.
Vol. 36..No. 161.
Vol. 37..Nos. 201 to 275, inclusive, except Nos. 205 and 232.
Vol. 38..No. 232.

EXECUTIVE DOCUMENTS INDEX.

Subject.	No.	Vol.
Agricultural Department. (*See* Department of Agriculture.)		
Alaska, estimate for survey of boundary of	154	35
natives of Seal Island, request for appropriation for food, etc	111	34
Albatross (steamer), estimate for expenses of, in Bering Sea	168	35
estimate of deficiency by trip to Alaska	103	34
Algiers, La., report of survey to locate dry dock at	79	33
American Association of Students (Paris), relative to rent of building for	165	35
Antietam, estimate for battle lines and sites at	146	35
Appropriations, Alaska, natives of Seal Island	154	35
to complete survey of boundary	111	34
annual, Book of Estimates of	5	26
bailiffs and criers in District of Columbia	220	37
Board of Lady Managers, World's Columbian Exposition	157	35
Cheyenne and Arapahoe Indians, for support of	198	35
claims against United States, defending suits in	150	35
Court of Claims, for additional room for files	186	35
Court of Private Land Claims, for printing notice of organization of	224	37

Subject.	No.	Vol.
Appropriations, courts, additional, for	223	37
deficiencies	194	35
customs, collection of	11	29
deficiencies in Department of the Interior	131	34
deficiencies in Department of Justice	201	37
	245	37
deficiency estimates for subsistence of the Sioux Indians	64	33
deficiency for fees and expenses of examining surgeons	217	37
Department of Justice, marshals, etc. (deficiency)	267	37
District of Columbia (deficiency)	253	37
Eleventh Census, to continue	51	33
estimates of deficiencies in, of the various Departments	94	26
	205	26
Indian service, deficiencies	145	35
Intercontinental Railway Commissioners, salary of	113	34
money-order system, increase in	213	37
ocean mail service	219	37
Pacific Branch, Soldiers' Home, for improvement of	141	35
permanent and indefinite, letter relative to House bill 448, to repeal	152	35
postal service (deficiency)	192	35
post traders' buildings, to purchase	207	37
prisons, erection of	130	34
Rainy Lake River, to establish Government post at mouth of	158	35
revenue steamer for Baltimore (additional)	122	34
Rock Island Arsenal	191	35
State Department, printing and binding	242	37
to enforce Chinese exclusion acts	244	37
Treasury Department, additional space for	248	37
Utah penitentiary	139	35
	115	34
War Department, for printing and binding	136	35
Washington (D. C.) post-office	140	35
World's Columbian Exposition, Government exhibit	153	35
World's Columbian Exposition, postal service	246	37
Arms, obsolete, etc., relative to disposition of	174	35
Army, relative to—		
brevet rank, relative to amendment of act of February 27, 1890	249	37
brevets of, relative to Senate bill 2699, relating to	269	37
desertions from	209	37
infantry arm, petition relative to bill (Senate) for reorganization	239	37
relief of certain officers of the Pay Department of	135	34
sergeant of ordnance, letter relative to clothing allowance for	48	33
transportation, list of claims allowed for	258	37
report of Secretary of War on civilian employés in	19	29
to print drill regulations	250	37
Arapahoes. (*See* Indians.)		
Arbitration, relative to appropriation for, between United States and Great Britain	212	37
Arizona, relative to unsurveyed lands in	214	37
Arlington Cemetery, relative to burial of families of officers in	231	37
Attorney-General:		
Communications from—		
Annual report of	7	22
Beers, C. W., claim of	195	35

Subject.	No.	Vol.
Attorney-General:		
Communications from—		
Claims of bailiffs for 1889, estimates for payment of	257	37
Claims of bailiffs, New Jersey district, submitting papers on	259	37
Court of Claims, list of unpaid costs in	266	37
Court of Private Land Claims, letter relative to increasing appropriation for	84	34
Courts, estimates for additional appropriations for	223	37
of deficiency in appropriations	194	35
Department of Justice, list of minor employés in	247	37
	201	37
deficiencies in	245	37
submitting deficiency estimates for marshals, etc	267	37
District of Columbia, relief of bailiffs and criers of the Supreme Court of	220	37
English, Allen R., submitting estimate for payment of services	215	37
Fox and Wisconsin rivers, award of damages incident to improvement of	222	37
Government dams, submitting papers relative to injury to Mississippi River in Minnesota	178	35
Judgments, submitting list of, rendered against United States since February 9, 1891	9	29
list of, rendered in circuit and district courts	243	37
McNeils Island penitentiary, relative to water supply of	78	33
Mission Indians, relative to continuing special attorney for	97	34
Prisons, letter requesting appropriation for erection of	130	34
Reading Railroad Company, response to resolution of House as to whether it has violated the antitrust law	238	37
Sugar trust, response to inquiry of the House relative to suit against	225	37
United States prisons, relative to appropriations to erect	130	34
Utah penitentiary, estimate for electric-light plant	115	34
estimates of appropriations	139	35
transmitting letters of U. S. marshal relative to, part 2	139	35
Barnegat and Navesink, N. J., to reconvey site to owners at	149	35
Beers, C. W., claim of	195	35
Big Sandy River, Kentucky, report on movable dam near Louisa	25	29
Big Stone Lake, report of survey	127	34
Bishop, Joshua, petition for relief	50	33
Board of Ordnance and Fortification, report of	12	29
Bonds of United States, response to resolution of House relative to extension of 4½ per cents	134	34
Borland, T. R., attorney, expenses of, in procuring land for lighthouse depot at Portsmouth	230	37
Brazos River, Texas, report of examination of	63	33
Brunswick Outer Bar, Georgia, report of survey	34	30
Bureau of Statistics (*see* also Treasury Department):		
Report of foreign commerce, etc., part 1	6	27
Report on internal commerce, part 2	6	28
Canopitsit Channel, Massachusetts, report of survey	59	33
Cape Fear River, North Carolina, estimates for lighting new channel in	117	34
Cheyennes. (*See* Indians.)		
Chicago, Ill., papers, etc., relative to question of jurisdiction of harbor of	270	37
Chile, message of the President on	91	34
Chinese exclusion acts, estimates of appropriation to enforce	244	37
Chippewas. (*See* Indians.)		
Civilian engineers, list of, employed on rivers and harbors, compensation, etc	75	33
Civil Service Commission, annual report of	1	22

Subject.	No.	Vol.
Claims:		
Allowed by accounting officers and paid from indefinite appropriations	184	35
Allowed by accounting officers of the Treasury Department (exhausted balance, etc.)	199	35
Bailiffs for 1880, estimates for payment of	257	37
New Jersey district, for 1891	259	37
Certain, of Oregon and Washington Indian war	203	37
Deficiency in appropriation for defending suits in, against United States	150	35
Services of deputy marshals in Alabama	144 210	35 37
Under Fourth of July act allowed since February 1, 1891	208	37
Clarendon and Lower White rivers, Arkansas, report of survey	118	34
Coast and Geodetic Survey, report of changes made in force of	180	35
expenditures for 1891	151	35
Superintendent of, part 1	43	31
part 2	43	32
Coinage, gold and silver, response to House resolution asking amount of, from June 30, 1891, to March 1, 1892	177	35
Columbia (Tenn.) Arsenal, supplemental appropriations for	121	34
Columbia (Upper) River and Aucke River, letter suggesting extension of improvement to Asotin	77	33
Columbia River, report of Secretary of War on survey of	38	30
Washington, report on survey of	36	30
Commercial relations, report of United States consuls on	204	37
Commissioner of Indian Affairs, annual report of disbursements of	8	29
communication from, relative to legalizing records in Indian Office	73	33
Commissioner of Internal Revenue, report of	4	22
Commissioner of Labor, seventh annual report of	232	38
Comptroller of the Currency, annual report, part 1	3	24
(report on national banks) part 2	3	25
Conneaut Harbor, Ohio, report of survey	42	30
Constantinople, salary of interpreter at	110	34
Consuls, report of, on commercial relations	204	37
Contract labor laws, report of expenditures for enforcement of	162	35
Court of Claims, estimate of appropriation for additional space for files of	186	35
list of judgments rendered by	211	37
list of costs in defending the Government in suits in	266	37
Court of Private Land Claims, relative to increasing estimates for	84	34
estimates for printing notice of organization of	224	37
Courts of United States:		
Bailiffs and criers in supreme court of the District of Columbia, payment of wages to	220	37
Claims of bailiffs of, for 1887, estimates for payment of	257	37
Claims of bailiffs of New Jersey district for 1891	259	37
Deficiency in appropriation for	194	35
Estimates for additional appropriations for	223	37
Judgments, list of, rendered in, as against the United States	243	37
Crooks, James, claim of	95	34
Currency, relative to free transportation of	68	33
report of Comptroller of, part 1	3	24
Customs duties, etc., letter with detailed statement of	124	34
Customs, estimate of appropriations for collection of	11	29
Customs service, official emoluments of officers in	120	34
estimate of appropriation for, in connection with World's Fair	260	37
Cypress Bayou, Louisiana and Texas, report on survey	126	34
Deer Point, Pensacola Bay, Florida, estimate to erect light	167	35

Subject.	No.	Vol.
Deficiencies. (*See* Appropriations.)		
Delaware Bay, report of estimate, etc., for harbor of refuge	112	34
Department of Agriculture, annual report of Secretary on	1	20
statement of expenditures in the	55	33
Department of the Interior, annual report on operations of	1	14–16
contingent expenses, statement of expenditures for	47	33
Office of Indian Affairs, in relation to a chief clerk for	193	35
Department of Justice, deficiency estimates for marshals, etc	267	37
employés in, list of minor	247	37
estimates of deficiencies in	201, 245	37
Department of State, consulates, estimates of deficiency for contingent expenses of	263	37
estimates of appropriation for printing and binding for	242	37
manuscript papers, letters, relative to binding of	164	35
public documents, relative to Senate bill 1549, for distribution, etc., of	189	35
Desert lands. (*See* Public lands.)		
Director of the Mint, annual report	200	35
District of Columbia, annual report of Commissioners of	1	29
electrical commission, report of	15	27
estimates of deficiencies in appropriations	253	37
rent of buildings in, by the Government	241	37
report of superintendent of charities of	46	30
statement showing buildings rented in, by Post-Office Department	227	37
supplemental estimates of deficiencies in appropriations for	233	37
Doboy and Sapelo, Georgia, report of survey of inner route between	62	33
Dominican Republics, response to House resolution relative to concessions by	123	34
statement of imports and exports to, 1890 and 1891	106, 107	34
Dry dock, Gulf of Mexico, report of survey	79	33
Eastern Branch, Potomac River, letter of Secretary of War with report of survey	30	30
Educational report	1	19
Electrical Commission of the District of Columbia, report on location, arrangement, and operation of electric wires	15	29
Eleventh Census, request for immediate action on estimate to continue	51	33
Elliott, George H., for relief of	143	35
Ellis Island, receipts on account of immigrant station at	147	35
Engineers, annual report of Chief of	1	3–8
English, Allen R., estimates to pay for services	215	37
Examining surgeons, letter transmitting deficiency estimates for fees and expenses of	217	37
Fernandez, Joseph, relief of	185	35
Finance report, Secretary of the Treasury	2	23
Fish and Fisheries, *Albatross* (steamer), estimate relative to deficiency by expenses of, to Alaska	103	34
Fish hatchery, Vermont, estimates for completion of	255	37
Fond du Lac Chippewas. (*See* Indians.)		
Foreign commerce and navigation, etc., report of Chief of Bureau of Statistics on	6	27
Foreign relations	1	1
Fortifications, armament of, special estimate for	182	35
Fort Monroe, Va., estimates for sewerage system of	172	35

Subject.	No.	Vol.
Fort Sullivan Reservation, Eastport, Me., draft of bill restoring to War Department	237	37
Fourth of July claims, list of, examined and allowed since February 1, 1891	208	37
Fox and Wisconsin rivers, award of damages incident to improvement	222	37
Geographic names, report of United States board of	16	29
Geological Survey, part 1 (geology)	1	17
part 2 (irrigation)	1	18
Gilman, John R., claim of	85	34
Gold and silver certificates, report of, issued since 1878	160	35
Government—		
Deficiency in appropriation for defending suits for claims against	150	35
Rent of buildings in District of Columbia by the	241	37
Report with list of judgments rendered against	9	29
Grand Army of the Republic, letters recommending appropriation for reception and entertainment of, in the District of Columbia	173	35
Grand Rapids, Mich., report of survey below Grand Rapids	197	35
Grand River, Ohio, report of survey	61	33
Great Lakes, report on obstructions to navigation in	24	29
Greenville, S. C., relative to heating apparatus for public building at	188	35
Guns, estimate of appropriation for machine guns of small-arms caliber	129	34
type, and others, report showing cost of	13	29
Harlan and Hollingsworth Company, claim of	202	37
Hot Springs, Ark., Army and Navy hospital, estimates for improvement, etc., of grounds	156	35
Hudson River, report relative to improvement of navigation of	23	29
Immigration and tonnage, report of Chief of Bureau of Statistics on	6	27
Indian Department, table of disbursements for, etc	8	29
Indian lands, relative to illegal grazing of cattle on	265	37
Indian Office:		
Communication from Commissioner of Indian Affairs relating to legalizing records in	73	
Payment of certain per diem clerks	133	33
Indian service, estimate of deficiency in appropriations for	145	34
Indians:		35
Arapaho, Cheyenne, estimate of support of	198	
Cheyenne and Arapaho land in Oklahoma	10	35
Chippewas in Minnesota, estimates for relief and civilization of	104	29
Fond du Lac, Chippewas, estimates for appropriation for	80	34
Kickapoos, agreement of Cherokee Commission with	72	34
Land patents, relative to acceptance and surrender of certain, and cancellation of	273	33
Legal costs incurred by, in contests relating to public lands, estimate for payment		37
Missions, estimate to continue attorney for	83	
Pyramid Lake Reservation, agreement entered into with	97	24
Report of subsistence of, who have no treaty funds, etc	71	34
Shoshone and Arapaho, agreement entered into with	66	33
Sioux, deficiency estimates for subsistence of the	70	33
Warm Springs Reservation, report on correct location of, etc	64	33
Umatilla Reservation, estimate of cost of sale and allotment of	69	33
Indian Territory:	82	33
Illegal grazing of cattle on certain lands in		34
Inspectors of mines, message of President transmitting petition of miners for appointment of	265	37
Inspector-General, report of (*see* also War Department)	132	
Intercontinental Railway Commissioners, estimate of appropriation to pay salaries	1	34
Interior Department. (*See* Department of the Interior.)	113	11
		34

Subject.	No.	Vol.
Internal commerce, report of Chief of Bureau of Statistics on	6	28
Internal revenue, report of Commissioner	4	22
Interstate Commerce Commission, additional estimate for litigation to carry out orders of	170	35
Iron and steel, report of tests on (1891)	161	36
Jamaica Bay, New York, report of survey of	29	30
Judgments, report of, rendered against the United States since February 9, 1891	9	29
Kennebec River, Maine, report of survey of, from Waterville to Augusta	76	33
Kettlewell, S. H., relative to claim of	88	34
Keystone National Bank, estimate of appropriation for investigation of	119	34
Kickapoos. (*See* Indians.)		
Labor, seventh annual report of the Commissioner of	232	38
Land entries, list of, adjudicated	100	34
Lights:		
Relative to erection of, etc., Cape Fear River, North Carolina	117	34
Deer Point, Pensacola Bay, Florida	167	35
Salem Creek, New Jersey	89	34
Seul Choix Point, Michigan	190	35
Southwest Ledge, Connecticut	90	34
Willamette River, Oregon (mouth of)	116	34
Los Angeles, Cal., relative to heating apparatus for public building at	188	35
Lowry, James M., relative to act for relief of	87	34
Lynn Haven Bay, Virginia, report on survey	27	29
Macmaster & McGibbon, relative to claim of	251	37
McNeils Island, Washington, relative to water supply of penitentiary at	78	33
Mail service, new service established on railroads since March 4, 1889	272	37
Marine Corps, relative to the appropriation for, for 1893	261	37
Marine-Hospital Service, to employ a laboratory attendant	252	37
Menemsha Bight, Mass., report of survey of	60	33
Military posts, estimate to construct buildings at, and to enlarge, etc	105	34
traders, builders' estimates of appropriation to pay for	207	37
Milwaukee, Wis., relative to sale of public building at	65	33
Miners, estimate of appropriation to carry out law for the protection of lives of, in the Territories	169	35
Minnesota, Government dams, relative to damage to, on Mississippi River, in State of	178	35
Mint, annual report of Director of	200	35
Mispillion River, Delaware, report of survey	57	33
Mississippi River, damage to Government dams on, in Minnesota	178	35
relative to backwater from, at Clarendon and Lower White River	163	35
report relative to damage done to navigation by logging companies in Minnesota	183	35
Missouri River, Montana, report of survey between Great Falls and Stubbs Ferry	114	34
Monks, John, & Son, claim of	206	37
Murderkill River, Delaware, report of survey of	21	29
National banks, report of Comptroller on	3	25
National Home for Disabled Volunteers, estimate of appropriation for improvement of Pacific branch of	145	35
relative to omission of dates in appropriation for, at Washington, D. C.	98	34
National Zoölogical Park, estimate of appropriation for	102	34

Subject.	No.	Vol.
Navy Department, list of employés in	92	34
printing and binding for, proposed amendment to Senate bill, relative to	179	35
Navy report	1	12
Nell (United States launch), losses by employés on, by sinking of	93	34
New Mexico, relative to appropriation to new hall for use of the legislature of	236	37
relative to unsurveyed lands in	214	37
New River and Swansboro, N. C., report on survey of water way between	26	29
Ocean mail service, response of Postmaster-General to House resolution of inquiry	159	35
Oklahoma, claims of parties acting as deputy marshals	144 210	35 37
illegal grazing of cattle on certain lands in	265	37
Olympia Harbor, Washington, report on survey of	32	30
Pacific Coast, California, report of examination for deep-water harbor on	39	30
Paper, letter relative to disposition of useless, in Department of State	118	34
Patrol (U. S. S.) losses of crew of	264	37
Penobscot River, Maine, report on survey of	37	30
Pensions, estimate of deficiency in appropriations for	229	37
Port Day, New York, report of survey of	67	33
Postal service, estimates of deficiencies in	216 192	37 35
Postmaster-General:		
Communications from—		
Annual report	1	13
Conference of Postmasters, response to resolution of the House for information of	196	35
District of Columbia, statement in response to House resolution of buildings rented by Post-Office Department	227	37
Post-office appropriation bill	226	37
Mail service, response to House resolution of inquiry relative to new service established on railroads since March 4, 1889	272	37
Ocean mail service, response to House resolution of inquiry	159	35
Post-Office Department, relative to increase of force in money-order division	213	37
Washington (District of Columbia) post-office, letter relating to appropriation for equipment	140	35
World's Columbian Exposition, relative to postal service for	246	37
Postmasters, report of Postmaster-General relative to conference of, at Washington, D. C	196	35
Post-Office Department, estimates for increase of force in money-order division	213	37
Letter of Postmaster-General relating to appropriation bill for the	226	37
Potomac River (eastern branch), report of survey	30	30
Potomac River (up to Washington), report of survey	32	30
President of the United States:		
Communications from—		
Annual message and foreign relations	1	1
Chile, concerning outrages on American sailors	91	34
Crooks, James, transmitting message relative to claim of	95	34
Dominican Republics, transmitting reply to House resolution for information of concessions granted by the	123	34
Dry Dock, Gulf of Mexico	79	33
Geographic names, letter transmitting report of United States board of	16	29
Grand Army of the Republic, transmitting communication from the Commissioners of the District of Columbia relative to an appropriation for reception of, etc	173	35

Subject.	No.	Vol.
President of the United States:		
Communications from—		
Inspector of mines in Indian Territory, transmitting petition of miners for	132	34
Kickapoo Indians, transmitting agreement with	72	33
Mission Indians, transmitting report of commission on relief of	96	34
Pyramid Lake Reservation, transmitting agreement entered into with Indians on	71	33
Shoshone and Arapaho Indians, transmitting agreement with	70	33
World's Columbian Commission, transmitting report of	142	35
Price, Rodman M., relative to act for relief of	45	30
Printing. (*See* Public Printer.)		
Prisons, estimates for erection of	130	34
Public documents, report from Secretary of the Interior on receipt, distributions, and sales of by Department of the Interior	74	33
Public Lands:		
Desert-land law, relative to amount issued under	187	35
List of adjudicated land entries	100	34
Public Printer, letter from, containing estimates of deficiencies for printing	137	25
Puerto Rico. (*See* Dominican Republics, etc.)		
Puget Sound, Washington, report on cost, etc., of canal to connect Lakes Union, Samamish, and Washington with	40	30
Rainy Lake River, request for appropriation to establish Government post at mouth of	158	35
Reading Railroad Company, response to resolution of inquiry from House as to violation of antitrust law by	238	37
Red Cross, estimate of appropriation to represent United States at Fifth International Conference	176	35
Red River of the North, Minnesota, survey of above Fergus Falls and Crookston	127	34
Requisitions, letter of Secretary of Treasury in response to resolution of inquiry as to unpaid	218 274	37 37
Revenue-Cutter Service, estimates for steamer for Baltimore, Md	122	34
estimates to construct vessels for	85	34
Rifle competitions, relative to commutation of rations for contestants in	166	35
Rock Hall Harbor, Maryland, report of survey	56	33
Rock Island Arsenal, estimate of appropriation for	191	35
Rock Island Arsenal and bridge, supplemental estimates of appropriations for	121	34
Sabine River, Texas, report of examination of	20	29
St. Mary Falls Canal, report of commerce passing through	18	29
St. Louis River, Minnesota and Wisconsin, report of survey	58	33
Salem Creek, New Jersey, to establish light at mouth of	89	34
Salt, letter of Secretary of Treasury, with certain information relative to importation of	148	35
San Diego, post and harbor defenses near, report of examination for site	14	29
San Joaqun River, California, report of survey of	108	34
Savannah-Fernandina Waterway, report of survey	41	30
Seal Islands. (*See* Alaska.)		
Secretary of Agriculture:		
Communication from—		
Annual report of	1	20
Department of Agriculture, detailed statement of expenditures of	55	33
Secretary of the Interior:		
Communications from—		
Annual report of (in five volumes)—		
The Secretary (vol. 1)	1	14
The Secretary (vol. 2)	1	15
The Secretary (vol. 3)	1	16

Subject.	No.	Vol.
Secretary of the Interior:		
Communications from—		
Cheyenne and Arapaho Indians, estimate of appropriation for support	198	35
Commissioner of Labor, seventh annual report	232	38
Deficiencies, letter of estimates of additional, in appropriations for Interior Department	131	34
Department of Interior, contingent expenses, statement of expenditures for	47	33
Desert land law, response to House resolution asking for information as to disposal of public land under	187	35
Director of the Geological Survey, part 1	1	17
Director of the Geological Survey, part 2	1	18
Educational report	1	19
Examining surgeons, estimates of fees and expenses of	217	37
Gilman, John R., submitting papers in claim of	86	34
Indians, Chippewas, in Minnesota, submitting estimates for relief and civilization of	104	34
estimates to pay costs of, in public land contests	83	34
Fond du Lac Chippewa, estimates for	80	34
statement of subsistence for, who have no treaty funds, etc	66	33
Umatilla Reservation, estimates of, cost of sale, and allotment of	82	34
Indian land patents, relative to authority to accept and cancel certain	273	37
Indian lands, response to House resolution relative to illegal grazing of cattle on, in Indian Territory and Oklahoma	265	37
Indian Office, letter relative to appropriation to pay certain per diem clerks in	133	34
Indian service, estimate of appropriation for deficiencies in	145	35
Kickapoo Indians, submitting agreement with	72	33
Land entries, transmitting list of adjudicated	100	34
Miners, submitting estimates to carry out provisions of law for protection of, in the Territories	169	35
Mission Indians, estimates to continue special attorney for	97	34
transmitting report of Commission for relief of	96	34
New Mexico and Arizona, response to resolution of House relative to unsurveyed lands in	214	37
Office of Indian Affairs, request for a chief clerk in	193	35
Oklahoma, lands of Cheyennes and Arapahoes in	10	29
Pensions, submitting estimates of deficiency in appropriations for	229	37
Public documents, report of receipt, distribution, and sales of, etc	74	33
Pyramid Lake Reservation, submitting agreement entered into with	71	33
Records of Indian Office, communication relative to legalizing	73	33
Shoshone and Arapaho Indians, submitting agreement of	70	33
Warm Springs Indian Reservation, Oregon, report of commissioners on correct location of	69	33
Wilson & Goss, for relief of	254	37
Secretary of the Navy:		
Communications from—		
Annual report	1	12
Bishop, Joshua, submitting petition of, for relief	56	33
Dry dock, Gulf of Mexico, report of survey	79	33
Harlan and Hollingsworth Company, claim of	202	37
Hot Springs Army and Navy Hospital, estimate for improvement of grounds of	156	35
Marine Corps, relative to the appropriation for 1893 for	261	37
Monks, John & Son, papers relating to claim of	206	37
Navy Department, trasmitting list of employés in	92	34

Subject.	No.	Vol.
Secretary of the Navy:		
Communications from—		
Printing and binding for Navy Department, proposed amendment to Senate bill relating to	179	35
Vanderbilt, F. W., papers in claim of	206	37
Secretary of State:		
Communications from—		
Alaska, relative to appropriation for survey of boundary of	111	34
American association of students (Paris) submitting papers relative to	165	35
Arbitration, request for appropriation to execute treaty with Great Britain	212	37
Constantinople, submitting estimates for interpreter at	110	34
Consulates, estimates of deficiencies for contingent expenses of	263	37
Crooks, James, submitting papers in case of	95	34
Dominican Republics, letter of, relative to concession of	123	34
Manuscript papers, relative to binding of, for Department of State	164	35
Papers, letter relative to disposition of useless	128	34
Printing and binding for State Department, letter relative to appropriations	242	37
Secretary of the Treasury:		
Communications from—		
Annual report on finances	2	23
Alaska, transmitting estimate for survey of boundary of	111	34
Albatross (steamer), estimate of expenses of, in Bering Sea	168	35
transmitting estimates of deficiency caused by sending to, Alaska under direction of the President	103	34
Antietam, estimates for battle lines and sites at	146	35
Appropriations, Annual Book of Estimates	5	26
deficiency for the various Departments	94, 205	26
permanent and indefinite, letter relative to House bill 448 to repeal	152	35
Arbitration, transmitting request for appropriation for, between United States and Great Britain	212	37
Armament of fortification, transmitting estimates for	182	35
Army, Pay Department, transmitting letter relative to relief of	135	34
Army transportation, submitting list of claims for, allowed	258	37
Association of American students (Paris), transmitting letter relative to rent of building for	165	35
Assistant register, to amend law for substitute in case of vacancy, etc	256	39
Barnegat and Navesink, N. J. to reconvey site to owner	149	35
Beers, C. W., claim of	195	35
Bonds of United States, response to resolution of House relative to extension of 4½ percents	134	34
Bureau of Statistics, request for additional clerk for	228	37
Cape Fear River, North Carolina, transmitting estimates for lighting new channel in	117	34
Cheyenne and Arapaho Indians, estimates for appropriation for support	198	35
Chicago, Ill., transmitting letter relative to jurisdiction over harbor of	270	37
Chinese exclusion acts, estimates of appropriation to enforce	244	37
Claims, deficiency in appropriation for defending suits in, against United States	150	35
allowed by accounting officers, letter with list of (exhausted balances due)	199	35
allowed by accounting officers and paid from indefinite appropriations	184	35

Subject.	No.	Vol.
Secretary of the Treasury:		
Communications from—		
Claims, certain, of Oregon and Washington Indian wars	203	37
of bailiffs, transmitting estimate for payment of certain, for 1889	257	37
of bailiffs of New Jersey district for 1891, transmitting letter relating to	259	37
Coast and Geodetic Survey, transmitting report of changes in	180	35
transmitting report of expenditures of, 1891	151	35
Coinage, gold and silver, response to House resolution asking amount of, from June 30, 1891, to March 1, 1892	177	35
Columbia (Tenn.) Arsenal, transmitting letter of supplemental estimates for	121	34
Commissioner of Internal Revenue	4	22
Contract labor laws, report of expenditures for enforcement of	162	35
Court of Claims, estimates of appropriations for additional space for files of	186	35
transmitting list of costs unpaid in suits in	266	37
transmitting lists of judgments of	211	37
Court of Private Land Claims, accounts for printing notice of organization of	224	37
transmitting letter for increasing estimates for	84	34
Courts of the United States, estimates for additional appropriations for	223	37
transmitting estimates of deficiency in appropriations	194	35
Currency, relative to free transportation of	68	33
Customs, submitting estimates of appropriations for collection of revenue from	11	29
Customs duties, etc., detailed statement of refund of	124	34
Customs service, transmitting abstract of official emolument of officers in	120	34
Deer Point, Pensacola Bay, Fla., estimate to erect light	167	35
Department of Interior, transmitting letter of additional estimates of deficiencies in	131	34
Department of Justice, estimates of deficiencies in	201; 245	37; 37
Department of State, for printing and binding	242	37
transmitting letter relative to pay of interpreter at Constantinople	110	34
transmitting estimates of deficiency for contingent expenses of consulates	263	37
transmitting letter relative to binding manuscript papers in	164	35
District of Columbia, submitting supplemental estimates of deficiencies in appropriations for	233	37
rent of buildings in, response to House resolution	241	37
transmitting estimates of deficiency in appropriations	253	37.
transmitting report of superintendent of charities	46	30
Dominican Republics, etc., submitting statement of exports and imports to, 1890, 1891	106; 107	34
Eleventh Census, request for immediate action on estimates to continue	51	33
Ellis Island, response to House resolution for receipts on account of immigrant station on	147	35
English, Allen R., transmitting estimate to pay for services of	215	37

Subject.	No.	Vol.
Secretary of the Treasury:		
Communications from—		
Examining surgeons, letter transmitting deficiency estimates for fees and expenses of	217	37
Fernandez, Joseph, relief of	185	35
Fish hatchery, Vermont, transmitting estimate for completion of	255	37
Fort Monroe, transmitting estimates for sewerage system for	172	35
Foreign commerce and navigation, report of chief of the Bureau of Statistics on (part 1)	6	27
Fourth of July claims, list allowed since February 1, 1891	208	37
Fox and Wisconsin rivers, award of damages incident to improvement of	222	37
Gilman, John R., transmitting letter relating to claim of	86	34
Gold and silver certificates, report of, issued since January 1, 1878	160	35
Guns, machine, of small arms caliber, transmitting letter relative to	129	34
Harlan & Hollingsworth Company, claim of	202	37
Hot Springs Army and Navy Hospital, transmitting estimates for improvement, etc., of grounds of	156	35
Indians:		
Chippewas in Minnesota, transmitting estimates for relief and civilization of	104	34
Fond du Lac Chippewas, transmitting estimates	80	34
Land contests, transmitting letter relative to costs in cases of	83	34
Missions, transmitting estimates for attorney for	97	34
Report of commission for relief of	96	34
Umatilla Reservation, transmitting estimates of cost of sale and allotment	87	34
Indian Office, transmitting letter relative to appropriation for per diem	133	43
Indian Service, transmitting estimates of deficiencies in appropriations for	145	35
Intercontinental Railway Commissioners, transmitting estimate for salaries of	113	34
Internal commerce, report of Chief of the Bureau of Statistics on (part 2)	6	28
Interstate-Commerce Commission, transmitting additional estimates to carry out orders of	170	35
Kettlewell, S. H., submitting papers relative to claim of	88	34
Keystone National Bank, transmitting estimates of appropriation for investigation of	119	34
Lowry, James M., report relative to act for relief of	87	34
Macmaster & McGibbon, letter relative to claim of	251	37
McNeils Island, penitentiary, relative to water supply of	78	33
Marine Corps, transmitting letter relative to appropriations for 1893 for	261	37
Marine-Hospital Service, letter relative to employment of a laboratory attendant	252	37
Milwaukee, relative to sale of public building at	65	33
Miners, transmitting estimate to carry out provisions of law for protection of lives of, in the Territories	169	35
Monks, John & Son, transmitting letter relative to claim of	206	37
National Home for Disabled Volunteers, estimates of appropriation for improvement of Pacific branch of	141	35
National Zoölogical Park, transmitting estimate for	102	34
New Mexico, submitting papers relative to hiring hall for legislature of	236	37
Ocean mail service, estimates for	214	37
Official business, response to House resolution for information relative to request for leave of absence on	275	37

Subject.	No.	Vol.
Secretary of the Treasury: Communications from—		
Oklahoma, claims of deputy marshals for services	144 210	35 37
Paper for checks and drafts, submitting estimates for purchase of	175	35
Pensions, transmitting estimates of deficiency in appropriations for	229	37
Portsmouth (Va.) light-house depot, expenses of district attorney in connection with	230	37
Postal service, estimate of deficiencies in	192	35
submitting estimates of deficiencies in	216	37
Post-Office Department, transmitting letter relative to increase of force in money-order division	213	37
Price, Rodman M., transmitting papers relative to act for relief of	45	30
Prisons, transmitting letter asking for appropriations for erection of	130	34
Public buildings, estimate for heating apparatus in certain cities	188	35
Public documents, relative to Senate bill 1549 for distribution, etc., of	189	35
Public printing, transmitting estimates of appropriation for deficiencies	137	35
Rainy Lake River, request for appropriation for Government post at mouth of	158	35
Red Cross, submitting estimates of expenses of United States delegates to Fifth International Conference of	176	35
Requisitions, letter in response to inquiry of unfilled, prior to March 1, 1892	218	37
response to House resolution as to unpaid	274	37
Revenue-Cutter Service, estimates to construct vessels for	85	34
Revenue steamer for Baltimore, letter for additional appropriations for	122	34
Rock Island Arsenal and bridge, transmitting letter of supplementary estimates for	121	34
Rock Island Arsenal, estimate of appropriation	191	35
Salem Creek, New Jersey, submitting estimates, etc., for light at mouth of	89	34
Salt, response to House resolution for certain information relative to importation of	148	35
Seal Island, Alaska, request for appropriation for food, etc., for natives of	154	35
Seul Choix, Pointe, Mich., submitting letters relative to additional expenditures for light station at	190	35
Sioux Indians, deficiency estimates for sustenance of	64	33
Southwest Ledge, Conn., submitting facts relative to changing light, etc., to steam fog whistle	90	34
Springfield (Mass.) Arsenal, transmitting letter of supplemental estimates for	121	34
Statistical Abstract:		
Report for 1891	53	33
Submitting draft of a bill for annual printing of the	54	33
Subsidiary coin, estimates of appropriation for recoinage of	181	35
Sundry civil bill, relative to the elimination of certain lines from	271	37
Tin plate, response to House resolution relative to drawbacks on	138	35
Treasury Department:		
Additional space for certain employés in	248	37
Information relative to requests for leaves on official business	275	37
First Comptroller's office, relative to extra work by employés of	268	37
Report of contingent expenses	44	30

Subject.	No.	Vol.
Secretary of the Treasury:		
Communications from—		
Treasury notes, to extend act of 1872 to certain	262	37
United States prisons, request for appropriation to carry out act for erection of	130	34
Utah penitentiary:		
Transmitting estimate for electric light for	115	34
Transmitting letter of estimates of appropriation for	139	35
Vanderbilt, F. W., transmitting papers in claim of	206	37
Wandrian (English schooner) relative to appropriation to adjust damages to	234	37
War Department:		
Transmitting estimates for additional appropriations for in office of Inspector-General	240	37
Transmitting deficiencies in appropriation for printing and binding	136	35
Transmitting supplemental estimates	81	34
Washington, District of Columbia, post-office, transmitting letter relating to appropriations for equipment	140	35
Willamette River, Oregon, transmitting estimates for light at mouth of	116	34
Wilson & Gass, for relief of	254	37
World's Columbian Exposition:		
Appropriations and expenditures by the Government, statement in response to House resolution	101	34
Estimates for postal service for	246	37
Estimate of appropriation for customs service in connection with	260	37
Estimate for Board of Lady Managers of	157	35
Government exhibit, appropriation necessary	153	35
Secretary of War:		
Communications from—		
Annual report of	1	2
Engineers, part 1	1	3
Engineers, part 2	1	4
Engineers, part 3	1	5
Engineers, part 4	1	6
Engineers, part 5	1	7
Engineers, part 6	1	8
Ordnance	1	9
Signal officers	1	10
Arlington cemetery, relative to burial of families of officers in	231	37
Armament of fortifications, estimates for	182	35
Arms, obsolete, etc., submitting letter relative to disposition of	174	35
Army, brevet rank, relative to amendment of act of February 27, 1890	249	37
brevets, submitting letter relative to Senate bill 2699	269	37
communication relative to relief of certain officers of the pay department	135	34
infantry arm, submitting petition relative to reorganization of	239	37
report of civilian employés in the	19	29
sergeants of ordnance, transmitting letter relative to clothing allowance for	48	30
to print drill regulations	250	37
transmitting bill relating to desertions from	209	37
Big Sandy River, Kentucky, report on movable dam near Louisa	25	29
Big Stone Lake, report of survey	127	34
Board of Ordnance and Fortifications, letter transmitting report of	12	29
Brazos River, Texas, report of examination of	63	33
Brunswick Outer Bar, Georgia, report of survey	34	30

Subject.	No.	Vol.
Secretary of War:		
Communications from—		
Canopitset Channel, Massachusetts, report of survey	59	33
Civilian engineers, list of, etc., employed on river and harbor work	75	33
Clarendon and Lower White River, Arkansas, report of survey	118	34
Columbia (Tenn.) Arsenal, letter of supplemental estimates for	120	34
Columbia (Upper) and Snake rivers, letter suggesting extension of improvement to Asotin	77	33
Columbia River Washington, report on survey of	36	30
Conneaut Harbor, Ohio, report of survey	42	30
Cypress Bayou, Louisiana and Texas, report on survey	126	34
Delaware Bay, transmitting report of examination and estimate for harbor of refuge	112	34
Divisions of military information, letter relating to additional room for	221	37
Doboy and Sapelo, Georgia, report of survey of inner route between	62	33
Eastern Branch, Potomac River, report of survey of	30	30
Elliott, George A., relief of	143	35
Fort Monroe, Va., submitting estimates for sewerage system for	172	35
Fort Sullivan reservation, Eastport, Me., submitting draft of line to restore to War Department	237	37
Grand River, Michigan, report of survey of, below Grand Rapids	197	35
Grand River, Ohio, report of survey	61	33
Great Lakes, report on obstructions to navigation in	24	29
Guns, machine, of small-arms caliber, estimate of appropriation for purchase of	129	34
Hudson River, report relative to survey of	23	29
Inspector-General, report of	1	11
Inspector-General's office, submitting estimate for additional force in	240	37
Jamaica Bay, New York, report on survey of	29	30
Kennebec River, Maine, report of survey from Waterville to Augusta	76	33
Lynnhaven Bay, Virginia, report on survey	27	29
Menemsha Bight, Massachusetts, report of survey	60	33
Military establishment, report of expenditures for the contingent expenses of	49	33
Military posts, estimate to construct buildings at, to enlarge, etc	105	34
traders' buildings, request for appropriation to purchase	207	37
Mispillion River, Delaware, report of survey	57	33
Mississippi River, response to House inquiry relative to injury to navigation of, in Minnesota	183	35
response to House resolution relating to backwater at Clarendon and Lower White River, Arkansas	163	35
Missouri River, Montana, report of survey between Great Falls and Stubbs Ferry	114	34
Murderkill River, Delaware, report of survey	21	29
Nell (United States launch) submitting statement of losses of employés on, by sinking of	93	34
New River and Swansboro, N. C., report on survey of water way between	26	29
Olympia Harbor, Washington, report on survey of	32	30
Pacific Coast, California, report of examination for deep-water harbor on	39	30
Patrol (U. S. S.), submitting claim for losses of clothing by crew of	264	37

Subject.	No.	Vol.
Secretary of War:		
Communications from—		
Penobscot River, Maine, report on survey	37	30
Port Day, New York, report of survey of	67	33
Potomac River (up to Washington), report of survey	33	30
Printing and binding, relative to certain, for War Department	171	35
Puget Sound, Washington, report on cost, etc., of canal to connect Lakes Union, Samamish, and Washington with	40	30
Red River of the North, Wisconsin, survey of, above Fergus Falls and Crookston	127	34
Report of survey of Lower Willamette and Columbia rivers	38	30
Rifle competitions, submitting letter relative to rations for contestants in	166	35
Rock Hall Harbor, Maryland, report of survey	56	33
Rock Island Arsenal, estimates of appropriation for	191	35
Rock Island Arsenal and bridge, letter of supplemental estimates for	121	34
Sabine River, Texas, report of examination of	20	29
St. Louis River, Minnesota and Wisconsin, report of survey	58	33
St. Mary Falls Canal, transmitting report of commerce passing through	18	29
San Diego, report of examination for site for coast and harbor defenses	14	29
San Joaquin River, California, report of survey of	108	34
Savannah-Fernandina water way, report of survey	41	30
Soldiers' Home, Washington, D. C., transmitting letter requesting omission of dates in appropriations for	98	34
Springfield (Mass.) Arsenal, letter of supplemental estimates for	121	34
Surgeon-General's Office, relative to binding, etc., for	155	35
Susquehanna River, Maryland, report of survey	52	33
Swinomish Slough, Washington, report of survey	31	30
Tillamook Bay and Bar, Oregon, report of survey	35	30
Type and other guns, report on cost of	13	29
War Department, letter transmitting list of clerks and others employed in	17	29
Printing and binding, letter relative to deficiencies in appropriations for	136	35
West Galveston Bay, Texas, report of survey	22	29
Willamette River, Oregon, report of survey	28	29
Yazoo River, Mississippi, report on survey	125	34
Seul Choix Pointe, Mich., relative to additional expenditure for light station at	190	35
Shoshones (*see* Indians)	70	33
Signal officer, annual report	1	10
Sioux. (*See* Indians.)		
Smithsonian Institution, National Zoölogical Park, estimates of appropriation for	102	34
Snake River, letter suggesting extension of improvement of, to Asotin	77	33
Soldiers' Home, Washington, D. C., letter requesting omission of date in appropriations for	98	34
Pacific branch, estimate of appropriation for improvement of	145	35
Southwest Ledge, Conn., to replace light, etc., by steam fog whistle	90	34
Springfield (Mass.) Arsenal, supplemental estimates of appropriations	121	34
Statesville, N. C., relative to heating apparatus for public building at	188	35
Statistical abstract, draft of a bill to provide for annual printing of the	54	33
Report for 1891	53	33
Subsidiary coin, estimate of appropriation for recoinage of	181	35

Subject.	No.	Vol.
Sugar trust, report of suit filed against, for violation of law against trusts	225	37
Surgeon-General's Office, letter relative to binding, etc., for	155	35
Susquehanna River, Maryland, report on survey of	52	33
Swansboro and New River, North Carolina, report of survey of water way between	26	29
Swinomish Slough, Washington, letter of Secretary of War relative to improvement of	31	30
Territories, miners in, estimate to carry out law for protection of	169	35
Tests of iron and steel (1891)	161	36
Tillamook Bay and bar, Oregon, report of survey	35	30
Tin plate, response to House resolution relative to drawbacks on	138	35
Treasurer of the United States, annual report	2	23
Treasury, estimate for check and draft paper for	175	35
requisition on, relative to unpaid, to June 30, 1892	274	37
Treasury Department, additional room for certain divisions	248	37
Assistant Register, to amend law relative to substitute in case of vacancy, etc., in office of	256	37
Bureau of Statistics, relative to an additional clerk for	228	37
claims allowed by accounting officers (exhausted balances, etc.)	199	35
claims allowed by accounting officers of, and paid from indefinite appropriations	184	35
compensation, letter of the Secretary relative to eliminating certain lines in sundry civil bill relating to	271	37
First Comptroller's Office, relative to extra work by employés of	268	37
official business, relative to requests for of absence on	275	37
report of contingent expenses of	44	30
requests for leaves on official business	275	37
Treasury notes, to extend act of 1872 to certain	262	37
Type and other guns, report on cost of	13	29
Umatillas. (*See* Indians.)		
United States Coast and Geodetic Survey—		
Report of Superintendent of, part 1	43	31
Report of Superintendent of, part 2	43	32
United States prisons, relative to appropriations to erect	130	34
Utah penitentiary, estimates of appropriation for	139	35
estimates for establishing electric plant	115	34
letters of United States marshal relative to, part 2	139	37
Vanderbilt, F. W., claim of	206	35
Vicksburg, Miss., relative to heating apparatus for public building at	188	35
Wandrian (English schooner), relative to appropriation to adjust damages to	234	37
War Department:		
Annual report of Secretary	1	2
Clerks and others employed in, list of	17	29
Inspector-General's Office, relative to additional force for	240	37
Military establishment, report of contingent expenditures for	49	33
Printing and binding for, estimates of deficiency in appropriations for	136	35
Printing and binding for, letter of Secretary of War relative to	171	35
Relative to additional room space for division of military information	221	37
Supplemental estimates for the	81	34

Subject.	No.	Vol.
Warm Springs Reservation, Oregon, report of commissioners on correct location	69	33
Washington (D. C.) post-office, request for appropriation for equipment of	140	35
West Galveston Bay, Texas, report of survey	22	29
Willamette River, Oregon, estimates of appropriation for light at mouth of	116	34
report of Secretary of War on survey of lower	38	30
report of survey in Oregon	28	29
Wind River Reservation, agreement entered into by Shoshones and Arapahoes on	70	33
Wilson & Goss, for relief of	254	37
World's Columbian Commission, message of President submitting report of	142	35
World's Columbian Exposition:		
Appropriations and expenditures, statement of Government	101	34
Board of Lady Managers, estimates for expenses of	157	35
Government exhibit, report of appropriation necessary	153	35
Postal service for	246	37
Yazoo River, Mississippi, report on survey	125	34

ERRATA, Page 363.

3d line, for $2,379,085.16 read $2,416,250.16.
4th line, for 3,339,567.96 read 3,394,835.96.

52D CONGRESS, *1st Session.* } HOUSE OF REPRESENTATIVES. { Ex. Doc. 1, Part 2.

REPORT

OF THE

SECRETARY OF WAR;

BEING PART OF

THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

TWO HOUSES OF CONGRESS

AT THE

BEGINNING OF THE FIRST SESSION OF THE FIFTY-SECOND CONGRESS.

IN FIVE VOLUMES.

VOLUME II–IN SIX PARTS.

PART 1.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1891.

CONTENTS.

[Alphabetical index will be found at the end of each part.]

PART I.

OFFICERS OF THE CORPS OF ENGINEERS.

CHANGES during year, distribution of officers, 3; officers detached, recommendations as to examinations for promotion, 4.

FORTIFICATIONS.

GENERAL STATEMENT, 4; defense of Boston Harbor, Mass., 6; defense of New York Harbor, N. Y., defense of Washington, D. C., 7; defense of Hampton Roads, Va., defense of San Francisco Harbor, Cal., 8.

PROTECTION OF SITE OF FORT NIAGARA, NEW YORK.

IN THE CHARGE OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS 8

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR.

IN THE CHARGE OF COL. D. C. HOUSTON, CORPS OF ENGINEERS 9

SEA WALLS AT GOVERNORS ISLAND, NEW YORK HARBOR.

IN THE CHARGE OF COL. D. C. HOUSTON, CORPS OF ENGINEERS 9

BEACH PROTECTION, WATER SUPPLY, AND SEWERAGE SYSTEM AT FORT MONROE, VIRGINIA.

IN THE CHARGE OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS..... 10

REPAIR AND PRESERVATION OF FORT MARION, FLORIDA.

IN THE CHARGE OF CAPT. W. M. BLACK, CORPS OF ENGINEERS..... 11

ESTIMATES OF APPROPRIATIONS FOR FORTIFICATIONS REQUIRED FOR 1892-'93 11

THE BOARD OF ENGINEERS.

OFFICERS constituting Board, summary of reports rendered, 11; additional duties of individual members, 14.

POST OF WILLETS POINT, NEW YORK.—UNITED STATES ENGINEER SCHOOL.—BATTALION OF ENGINEERS.—ENGINEER DEPOT.

OFFICER IN COMMAND, LIEUT. COL. W. R. KING, CORPS OF ENGINEERS—

Post of Willets Point, United States Engineer School, Battalion of the Corps of Engineers, 15; Engineer Depot, statement of funds, 16.

RIVER AND HARBOR IMPROVEMENTS.

GENERAL STATEMENT, removal of wrecks, examinations and surveys, purchase of Portage Lake canals, Michigan, 17; harbor lines, bridges, 18; occupancy or injury of public works, engineer divisions, South Pass of the Mississippi River, 19.

ATLANTIC COAST AND GULF OF MEXICO.

IN THE CHARGE OF LIEUT. COL. JARED A. SMITH, CORPS OF ENGINEERS—

St. Croix River, Me., Lubec Channel, Me., 19; Mooseabec Bar, Me., Pleasant River, Me., 20; Narraguagus River, Me., breakwater from Mount Desert to Porcupine Island, Me., 21; Bagaduce River, Me., 22; Penobscot River, Me., Belfast Harbor, Me., 23; Camden Harbor, Me., 24; Rockport Harbor, Me., Rockland Harbor, Me., 25; Kennebec River, Me., Harraseeket River, Me., 26; Portland Harbor, Me., channel in Back Cove, Portland, Me., 27; breakwater at mouth of Saco River, Me., Saco River, Me., 28; Kennebunk River, Me., York Harbor, Me., 29; Portsmouth Harbor, N. H., Bellamy River, N. H., 30; Cocheco River, N. H.,harbor ot refuge at Little Harbor, N. H., 31; removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 32.

IN THE CHARGE OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS—

Newburyport Harbor, Mass., 33; Merrimac River, Mass., 34; Powow River, Mass., Ipswich River, Mass., 35; harbor of refuge, Sandy Bay, Cape Ann, Mass., Gloucester Harbor, Mass., 36; Manchester Harbor, Mass., 37; Salem Harbor, Mass., 38; Lynn Harbor, Mass., 39; Winthrop Harbor, Mass., Boston Harbor, Mass., 40; Weymouth River, Mass., Hingham Harbor, Mass., 42; Scituate Harbor, Mass., 43; Plymouth Harbor, Mass., Wellfleet Harbor, Mass., 44; Provincetown Harbor, Mass., 45; Chatham Harbor, Mass., examinations and surveys, 46.

IN THE CHARGE OF MAJ. W. R. LIVERMORE, CORPS OF ENGINEERS—

Harbor of refuge at Hyannis, Mass., harbor of refuge at Nantucket, Mass., 48; Marthas Vineyard inner harbor at Edgartown, Mass., 49; Vineyard Haven Harbor, Mass., Wareham Harbor, Mass., 50; New Bedford Harbor, Mass, 51; Westport Harbor, Mass., 52; Taunton River, Mass., 53; Pawtucket River, R. I., Providence River and Narragansett Bay, R. I., 54; removal of Green Jacket Shoal, Providence River, R. I., 55; Greenwich Bay, R. I., 56; cove and water-way near Coaster Harbor Island, R. I., Newport Harbor, R. I., 57; harbor of refuge at Point Judith, R. I., 58; harbor of refuge at Block Island, R. I., 59; Pawcatuck River, R. I. and Conn., harbor of refuge at Stonington, Conn., 60; removing sunken vessels or craft obstructing or endangering navigation, 61; examinations and surveys, 62.

IN THE CHARGE OF COL. D. C. HOUSTON, CORPS OF ENGINEERS—

Mystic River, Conn., Thames River, Conn., 63; New London Harbor, Conn., Connecticut River, Mass. and Conn., 64; Duck Island Harbor, Conn., Clinton Harbor, Conn., 66; New Haven Harbor, Conn., 67; breakwater at New Haven, Conn., 68; Milford Harbor, Conn., Housatonic River, Conn., 69; Bridgeport Harbor, Conn., Black Rock Harbor, Conn., 70; Norwalk Harbor, Conn., Wilson Point Harbor, Conn., 71; Five Mile River Harbor, Conn., Stamford Harbor, Conn., 72; Port Chester Harbor, N. Y., 73; Larchmont Harbor, N. Y., Echo Harbor, New Rochelle, N. Y., New Rochelle Harbor, N. Y., 74; East Chester Creek, N. Y., Greenport Harbor, N. Y., 75; harbor at Port Jefferson Inlet, N. Y., Huntington Harbor, N. Y., 76; Glen Cove Harbor, N. Y., Flushing Bay, N. Y., 77; Patchogue River, N. Y., 78; Brown's Creek, Sayville, N. Y., examinations and surveys, 79.

IN THE CHARGE OF LIEUT. COL. G. L. GILLESPIE, CORPS OF ENGINEERS—

Hudson River, N. Y., 81; harbor at Saugerties, N. Y., 82; harbor at Rondout, N. Y., 83; Wappinger Creek, N. Y., Harlem River, N. Y., 84; removing obstructions in East River and Hell Gate, N. Y., 86; Newtown Creek, N. Y., 87; Buttermilk Channel, New York Harbor, 88; Gowanus Bay, N. Y., 89; New York Harbor, N. Y., 90; Raritan Bay, N. J., 92; removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 93.

IN THE CHARGE OF CAPT. THOMAS L. CASEY, CORPS OF ENGINEERS—

Sumpawanus Inlet, N. Y., 94; Canarsie Bay, N. Y., 95; Sheepshead Bay, N. Y., 96; Arthur Kill, N. Y. and N. J., 97; channel between Staten Island and New Jersey, 98; Passaic River, N. J., 99; Elizabeth River, N. J., 100; Rahway River, N. J., 101; Raritan River, N. J., 102; South River, N. J., 103; Keyport Harbor N. J., Mattawan Creek, N. J., 104; Shoal Harbor and Compton Creek, N. J., 105; Shrewsbury River, N. J., Manasquan (Squan) River, N. J., 106; removing sunken vessels or craft obstructing or endangering navigation, examinations and survey, 107.

IN THE CHARGE OF MAJ. C. W. RAYMOND, CORPS OF ENGINEERS—

Delaware River, Pa. and N. J., 108; harbor between Philadelphia, Pa., and Camden, N. J., 110; Schuylkill River, Pa., 112; ice-harbor at Marcus Hook, Pa., ice-harbor at head of Delaware Bay, Del., 113; construction of iron pier in Delaware Bay near Lewes, Del., 114; harbor at Delaware Breakwater, Del., 115; Rancocas River, N. J., 116; Alloway Creek, N. J., Maurice River, N. J., 117; removal of wrecks from Delaware Bay and River, removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 118.

IN THE CHARGE OF WILLIAM F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED—

Wilmington Harbor, Del., 119; ice-harbor at New Castle, Del., 120; Appoquinnimink River, Del., Smyrna River, Del., 121; St. Jones River, Del., Mispillion Creek, Del., Broadkiln River, Del., 122; inland water-way from Chincoteague Bay, Va., to Delaware Bay, at or near Lewes, Del., 123; Susquehanna River, above and below Havre de Grace, Md., North East River, Md., 124; Elk River, Md., 125; Fairlee Creek, Md., Chester River, Md., from Crumpton to Jones Landing, 126; Choptank River, Md., Cambridge Harbor, Md., 127; Wicomico River, Md., 128; Manokin River, Md., Onancock Harbor, Va., 129; harbor at Cape Charles City, Va., and approaches by Chenton (Cherrystone) Inlet, 130; removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 131.

IN THE CHARGE OF COL. WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS—

Patapsco River and channel to Baltimore, Md., 132; James River, Va., 134; examination, 135.

IN THE CHARGE OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS—

Potomac River at Washington, D. C., 135; Potomac River at Mount Vernon, Va., Occoquan Creek, Va., 138; Aquia Creek, Va., 139; harbor at Breton Bay, Md., Nomini Creek, Va., 140; Patuxent River, Md., 141; Rappahannock River, Va., Urbana Creek, Va., 142; York River, Va., 143; Mattaponi River, Va., 144; Pamunkey River, Va., examinations and surveys, 145.

IN THE CHARGE OF CAPT. G. J. FIEBEGER, CORPS OF ENGINEERS—

Harbor of Norfolk, and its approaches, Va., 146; approach to Norfolk Harbor and the United States (Norfolk) navy-yard between Lambert Point and Fort Norfolk, 147; Hampton Creek and Bar, Va., Nansemond River, Va., 148; Chickahominy River, Va., 149; Appomattox River, Va., 150; inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C., through Currituck Sound, North Landing River, Va. and N. C., 151; Currituck Sound, Coanjok Bay, and North River Bar, N. C., examinations, 152.

IN THE CHARGE OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS—

Staunton River, Va., 153; Roanoke River, Va. and N. C., 154; Pasquotank River, N. C., Mackey Creek, N. C., 155; Ocracoke Inlet, N. C., Fishing Creek, N. C., 156; Pamlico and Tar rivers, N. C., 157; Contentnia Creek, N. C., Trent River, N. C., 158; Neuse River, N. C., 159; inland water-way between New Berne and Beaufort, N. C., 160; harbor at Beaufort, N. C., 161; inland water-way between Beaufort Harbor and New River, N. C., water-way between New River and Swansboro, N. C., 162; New River, N. C., 163; North East (Cape Fear) River, N. C., Black River, N. C., 164; Cape Fear River, N. C., above Wilmington, 165; Cape Fear River, N. C., at and below Wilmington, 166; Lockwood's Folly River, N. C., Yadkin River, N. C., 167; harbor at Georgetown, S. C., 168; Winyaw Bay, S. C., removing sunken vessels or craft obstructing or endangering navigation, 169; examinations, 170.

In the charge of Capt. Frederic V. Abbot, Corps of Engineers—

Waccamaw River to Waccamaw Lake, N. C. and S. C., 170; Lumber River, N. C. and S. C., Little Pedee River, S. C., 171; Great Pedee River, S. C., Clark River, S. C., 172; Mingo Creek, S. C., Santee River, S. C., 173; Wateree River, S. C., Congaree River, S. C., 174; Charleston Harbor, S. C., 175; Ashley River, S. C., Wappoo Cut, S. C., 176; Edisto River, S. C., 177; Salkahatchie River, S. C., Beaufort River, S. C., removing sunken vessels or craft obstructing or endangering navigation, 178; examination, 179.

In the charge of Capt. O. M. Carter, Corps of Engineers—

Savannah River and Harbor, Ga., 179; Savannah River, Ga., Darien Harbor, Ga., 180; Altamaha River, Ga., Oconee River, Ga., 181; Ocmulgee River, Ga., Brunswick Harbor, Ga., 182; Jekyl Creek, Ga., 183; Cumberland Sound, Ga. and Fla., removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 184.

In the charge of Capt. W. M. Black, Corps of Engineers—

St. Johns River, Fla., 185; Ocklawaha River, Fla., 186; Volusia Bar, Fla., 187; harbor at St. Augustine, Fla., northwest entrance, Key West Harbor, Fla., 188; Caloosahatchee River, Fla., 189; channel of Charlotte Harbor and Pease Creek, Fla., 190; Sarasota Bay, Fla., Manatee River, Fla., 191; Tampa Bay, Fla., 192; Withlacoochee River, Fla., harbor at Cedar Keys, Fla., 193; Suwanee River, Fla., 194; examinations, 195.

In the charge of Capt. Philip M. Price, Corps of Engineers—

Apalachicola Bay, Fla., 196; Apalachicola River, Fla., including Lee Slough, 197; Flint River, Ga., 198; Chattahoochee River, Ga. and Ala., 199; La Grange Bayou and Holmes River, Fla., 200; Choctawhatchee River, Fla. and Ala., 201; harbor at Pensacola, Fla., 202; Escambia and Conecuh rivers, Fla. and Ala., 203; Alabama River, Ala., 204; Tallapoosa River, Ala., 206; Coosa River, Ga. and Ala., 207; operating and care of canals and other works of navigation on Coosa River, Ga. and Ala., Cahaba River, Ala., 210; examinations, 211.

In the charge of Maj. A. N. Damrell, Corps of Engineers—

Mobile Harbor, Ala., 211; Warrior and Tombigbee rivers, Ala. and Miss., 212; Black Warrior River, Ala., from Tuscaloosa to Daniels Creek, 215; Noxubee River, Miss., Pascagoula River, Miss., 217; Chickasahay River, Miss., Bluff Creek, Miss., Leaf River, Miss., 218; harbor at Biloxi, Miss., Pearl River, Miss., below Jackson, 219; Pearl River, Miss., between Jackson and Carthage, Pearl River, Miss., between Edinburg and Carthage, Bogue Chitto, La., 220; examination, 221.

In the charge of Maj. James B. Quinn, Corps of Engineers—

Inspection of the improvement of the South Pass of the Mississippi River, 221; Chefuncte (Tchefuncte) River and Bogue Falia, La., Tickfaw River and its tributaries, La., 222; Amite River and Bayou Manchac, La., 223; Bayou La Fourche, La., Bayou Terrebonne, La., 224; Bayou Plaquemine, La., Bayou Courtableau, La., 225; Bayou Teche, La., mouth and passes of Calcasieu River, La., 226; harbor at Sabine Pass, Tex., 227; Sabine River, Tex., Neches River, Tex., removing sunken vessels or craft obstructing or endangering navigation, 228; examinations and survey, 229.

In the charge of Lieut. John Millis, Corps of Engineers—

Securing mouth of Bayou Plaquemine, La., from further caving, removing sunken vessels or craft obstructing or endangering navigation of New Orleans Harbor, La., 231.

In the charge of Maj. Charles J. Allen, Corps of Engineers—

Entrance to Galveston Harbor, Tex., 231; ship channel in Galveston Bay, Tex., 232; Trinity River, Tex., Cedar Bayou, Tex., 233; Buffalo Bayou, Tex., harbor at Brazos Santiago, Tex., 234; examinations and survey, 235.

WESTERN RIVERS.

In the charge of Capt. J. H. Willard, Corps of Engineers—

Red River, La. and Ark., 236; Red River above Fulton, Ark., 237; Ouachita and Black rivers, Ark. and La., 238; Ouachita River above Camden, Ark., 239; Bayou D'Arbonne, La., Bayou Bartholomew, La. and Ark., 240; Bayou Bœuf (Bœuf River) La., Tensas River and Bayou Maçon, La., 241; bayous Rondeway and Vidal, La., Big Black River, Miss., 242; Yazoo River, Miss., 243; Tchula Lake, Miss., Tallahatchee River, Miss., Steele Bayou and Washington Bayou, Miss., 244; Big Sunflower River, Miss., 245; Big Hatchee River, Tenn., Forked Deer River, Tenn., water gauges on Mississippi River and its principal tributaries, 246; survey of Cypress Bayou and the lakes between Jefferson, Tex., and Shreveport, La., 248; examinations, 249.

In the charge of Capt. H. S. Taber, Corps of Engineers—

Removing obstructions in Arkansas River, Ark., Ind. Ter., and Kans., 249; Arkansas River, Ark., Ind. Ter., and Kans., 250; Fourche River, Ark., 251; Petit Jean River, Ark., White River, Ark., 252; Cache River, Ark., 253; Little Red River, Ark., Black River, Ark. and Mo., 254; Black River, Mo., St. Francis River, Ark., 255; St. Francis River, Mo., Little River, Mo. and Ark., 256; examinations and survey, 257.

In the charge of Capt. S. W. Roessler, Corps of Engineers—

Examinations of Mississippi River, at Memphis Harbor, Tenn.; from Lake County, Tenn., to Fulton County, Ky., north and west of Reelfoot Lake, 257.

In the charge of Maj. A. M. Miller, Corps of Engineers—

Removing snags and wrecks from Mississippi River, 258; Mississippi River between the Ohio and Illinois rivers, 259; harbor at St. Louis, Mo., 260; Gasconade River, Mo., 261; Osage River, Mo., 262; Kaskaskia River, Ill., 263.

In the charge of Maj. E. H. Ruffner, Corps of Engineers—

Mississippi River between Des Moines Rapids and mouth of Illinois River, 263; examination, 264.

In the charge of Maj. A. Mackenzie, Corps of Engineers—

Operating snag boats and dredge boats on Upper Mississippi River, 264; Mississippi River between Minneapolis and Des Moines Rapids, 265; Des Moines Rapids, Mississippi River, operating and care of Des Moines Rapids Canal and Dry Dock, 266; examinations and survey, 267.

In the charge of Maj. W. A. Jones, Corps of Engineers—

Mississippi River above Falls of St. Anthony, Minn., reservoirs at headwaters of Mississippi River, 268; Chippewa River, including Yellow Banks, Wis., 270; St. Croix River, Wis. and Minn., Minnesota River, Minn., 271; Red River of the North, Minn. and N. Dak., 272; gauging Mississippi River at or near St. Paul, Minn., 273; examinations and survey, 274.

In the charge of Lieut. Col. Charles R. Suter, Corps of Engineers—

Examination of Missouri River, from the old mouth of Platte River, Little Point, to a point opposite Leavenworth; and at Weston, Mo., 275.

In the charge of Capt. Chas. F. Powell, Corps of Engineers—

Missouri River between the Great Falls, Mont., and Sioux City, Iowa, 275; Yellowstone River, Mont. and N. Dak., 276; examinations and surveys, 277.

In the charge of Lieut. Col. J. W. Barlow, Corps of Engineers—

Tennessee River above Chattanooga, Tenn., and below Bee Tree Shoal, Ala., 278; Hiawassee River, Tenn., French Broad River, Tenn., 280; Clinch River, Tenn., 281; Cumberland River, Tenn. and Ky., 282; Caney Fork River, Tenn., 284; South Fork of Cumberland River, Ky., examinations and survey, 285.

IN THE CHARGE OF LIEUT. GEORGE W. GOETHALS, CORPS OF ENGINEERS—

Tennessee River between Chattanooga, Tenn., and foot of Bee Tree Shoals, Ala., 286; operating and care of Muscle Shoals Canal, Tennessee River, 287; examination, 288.

IN THE CHARGE OF LIEUT. COL. WILLIAM E. MERRILL, CORPS OF ENGINEERS—

Ohio River, 288; operating snag boats on Ohio River, operating and care of Davis Island Dam, Ohio River, movable dam in Ohio River near mouth of Beaver River, Pa., Monongahela River, W. Va. and Pa., 290; operating and care of locks and dams Nos. 8 and 9, Monongahela River, purchase of Lock and Dam No. 7, Monongahela River, purchase of Lock and Dam No. 6, Monongahela River, Cheat River, W. Va., 291; Allegheny River, Pa., dam at Herr Island, Allegheny River, 292; ice-harbor at mouth of Muskingum River, Ohio, Muskingum River, Ohio, operating and care of locks and dams on Muskingum River, Ohio, 293; examinations, 294.

IN THE CHARGE OF MAJ. G. J. LYDECKER, CORPS OF ENGINEERS—

Falls of the Ohio River, Louisville, Ky., 295; Indiana Chute, Falls of the Ohio River, operating and care of Louisville and Portland Canal, Ky., 296; Wabash River, Ind. and Ill., 297; White River, Ind., examination, 298.

IN THE CHARGE OF COL. WILLIAM P. CRAIGHILL, CORPS OF ENGINEERS—

Great Kanawha River, W. Va., 299; operating and care of locks and dams on Great Kanawha River, W. Va., Elk River, W. Va., 300; Gauley River, W. Va., 301; New River, from the mouth of Wilson, in Grayson County, Va., to the mouth of Greenbriar River, W. Va., 302; examination, 303.

IN THE CHARGE OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS—

Tradewater River, Ky., operating and keeping in repair locks and dams on Green and Barren rivers, Ky., 304; Rough River, Ky., Kentucky River, Ky., 305; operating and keeping in repair locks and dams on Kentucky River, Ky., Licking River, Ky., from Farmer to West Liberty, 306; Big Sandy River, W. Va. and Ky., Levisa Fork, Big Sandy River, Ky., 307; Tug Fork, Big Sandy River, W. Va. and Ky., Guyandotte River, W. Va., Little Kanawha River, W. Va., 308; Buckhannon River, W. Va., examinations, 309.

LAKE HARBORS AND RIVERS.

IN THE CHARGE OF CAPT. W. L. FISK, CORPS OF ENGINEERS—

Harbor at Grand Marais, Minn., 310; harbor at Agate Bay, Minn., harbor at Duluth, Minn., 311; harbor at Superior Bay and St. Louis Bay, Wis., 312; Minnesota Point, at Superior, Wis., harbor at Ashland, Wis., 313; harbor at Ontonagon, Mich., 314; Eagle Harbor, Mich., harbor at Marquette, Mich., 315; harbor of refuge at Grand Marais, Mich., resurvey and relocation of harbor line in Portage Lake, Houghton County, Mich., examinations and survey, 316.

IN THE CHARGE OF MAJ. CHARLES E. L. B. DAVIS, CORPS OF ENGINEERS—

Manistique Harbor, Mich., 317; Cedar River Harbor, Mich., Menomonee Harbor, Mich. and Wis., Menomonee River, Mich. and Wis., 318; Oconto Harbor, Wis., Pensaukee Harbor, Wis., 319; Green Bay Harbor, Wis., 320; harbor of refuge at entrance of Sturgeon Bay Canal, Wis., Ahnapee Harbor, Wis., 321; Kewaunee Harbor, Wis., Two Rivers Harbor, Wis., 322; Manitowoc Harbor, Wis., Sheboygan Harbor, Wis., 323; Port Washington Harbor, Wis., 324; harbor of refuge at Milwaukee Bay, Wis., Milwaukee Harbor, Wis., 325; Racine Harbor, Wis., Kenosha Harbor, Wis., 326; Waukegan Harbor, Ill., 327; Fox and Wisconsin rivers, Wis., 328; operating and care of locks and dams on Fox River, Wis., 329.

IN THE CHARGE OF CAPT. W. L. MARSHALL, CORPS OF ENGINEERS—

Chicago Harbor, Ill., 329; Calumet Harbor, Ill., 330; Calumet River, Ill. and Ind., 331; Illinois River, Ill., 332; operating and care of La Grange Lock, Illinois River, Ill., 333; Illinois and Mississippi Canal, 334; examination and survey, 335.

In the charge of Maj. William Ludlow, Corps of Engineers—

Petoskey Harbor, Mich., Charlevoix Harbor and entrance to Pine Lake, Mich., 336; Frankfort Harbor, Mich., harbor of refuge at Portage Lake, Mich., 337; Manistee Harbor, Mich., Ludington Harbor, Mich., 338; Pentwater Harbor, Mich., White River Harbor, Mich., 339; Muskegon Harbor, Mich., Grand Haven Harbor, Mich., 340; Holland (Black Lake) Harbor, Mich., 341; Saugatuck Harbor, Mich., South Haven Harbor, Mich., 342; St. Joseph Harbor, Mich., St. Joseph River, Mich., 343; Michigan City Harbor, Ind., 344; examination and survey, 345.

In the charge of Col. O. M. Poe, Corps of Engineers—

St. Marys River, Mich., 345; operating and care of St. Marys Falls Canal, Mich., dry dock at St. Marys Falls Canal, Mich., 346; Hay Lake Channel, St. Marys River, Mich., 347; harbor at Cheboygan, Mich., harbor at Thunder Bay, Mich., 348; Thunder Bay River, Mich., 350; harbor at Au Sable, Mich., Saginaw River, Mich., 351; harbor of refuge at Sand Beach, Lake Huron, Mich., 353; Black River at Port Huron, Mich., 354; mouth of Black River, Mich., 355; St. Clair Flats Canal, Mich., 356; operating and care of St. Clair Flats Canal, Mich., Clinton River, Mich., 358; Grosse Pointe Channel, Mich., 359; Rouge River, Mich., 360; Detroit River, Mich., removing sunken vessels or craft obstructing or endangering navigation, 361; examinations, 362.

In the charge of Maj. L. Cooper Overman, Corps of Engineers—

Monroe Harbor, Mich., 363; Toledo Harbor, Ohio, 364; Port Clinton Harbor, Ohio, 365; Sandusky City Harbor, Ohio, Sandusky River, Ohio, 366; Huron Harbor, Ohio, 367; Vermillion Harbor, Ohio, 368; Black River Harbor, Ohio, 369; Cleveland Harbor, Ohio, 370; Fairport Harbor, Ohio, 371; Ashtabula Harbor, Ohio, 372; examinations and surveys, 373.

In the charge of Maj. Amos Stickney, Corps of Engineers—

Erie Harbor, Pa., 373; preservation and protection of peninsula at Presque Isle, Erie Harbor, Pa., Dunkirk Harbor, N. Y., 374; Buffalo Harbor, N. Y., 375; Tonawanda Harbor and Niagara River, N. Y., Wilson Harbor, N. Y., 376; Olcott Harbor, N. Y., Oak Orchard Harbor, N. Y., 377; examination and survey, 378.

In the charge of Capt. Dan C. Kingman, Corps of Engineers—

Charlotte Harbor, N. Y., 378; Pultneyville Harbor, N. Y., 379; harbor at Great Sodus Bay, N. Y., harbor at Little Sodus Bay, N. Y., 380; Oswego Harbor, N. Y., 381; harbor at Sacketts Harbor, N. Y., 382.

In the charge of Maj. M. B. Adams, Corps of Engineers—

Shoal between Sister Islands and Cross-over Light, St. Lawrence River, N. Y., Ogdensburg Harbor, N. Y., 383; Grass River, N. Y., breakwater at Rouse Point, Lake Champlain, N. Y., 384; Great Chazy River, N. Y., breakwater at Gordon Landing, Lake Champlain, Vt., Plattsburg Harbor, N. Y., 385; Burlington Harbor, Vt., Otter Creek, Vt., 386; Ticonderoga River, N. Y., Narrows of Lake Champlain, N. Y. and Vt., 387; examinations, 388.

PACIFIC COAST.

In the charge of Col. G. H. Mendell, Corps of Engineers—

Oakland Harbor, Cal., 388; survey of San Francisco Harbor, San Pablo and Suisun bays, Strait of Carquinez, and mouths of San Joaquin and Sacramento rivers, Cal., 389.

In the charge of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers—

Napa River, Cal., 389; Redwood Harbor, Cal., Redwood Creek, Cal., 390; San Luis Obispo Harbor, Cal., Wilmington Harbor, Cal., 391; San Diego Harbor, Cal., 392; examinations, 393.

In the charge of Maj. W. H. Heuer, Corps of Engineers—

San Joaquin River, Cal., 394; Mokelumne River, Cal., 395; Sacramento and Feather rivers, Cal., 396; Petaluma Creek, Cal., Humboldt Harbor and Bay, Cal., 397; examination and survey, investigation of mining-débris question in State of California, 399.

IN THE CHARGE OF CAPT. THOMAS W. SYMONS, CORPS OF ENGINEERS—

Coquille River, Oregon, 399; entrance to Coos Bay and Harbor, Oregon, 401; Umpqua River, Oregon, Siuslaw River, Oregon, 402; Yaquina Bay, Oregon, 403; Tillamook Bay and Bar, Oregon, 404; Nehalem Bay, Oregon, Upper Columbia and Snake rivers, Oregon and Wash., 405; Columbia River between head of Rock Island Rapids and foot of Priest Rapids, Wash., 406; Chehalis River, Wash., 407; Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie rivers, Wash., 408; examinations and surveys, 409.

IN THE CHARGE OF MAJ. THOMAS H. HANDBURY, CORPS OF ENGINEERS—

Mouth of Columbia River, Oregon and Wash., 412; construction of canal at the Cascades, Columbia River, Oregon, 414; Columbia and Lower Willamette rivers below Portland, Oregon, 416; Willamette River above Portland, Oregon, 417; Cowlitz River, Wash., 418; Young's and Klaskuine rivers, Oregon, gauging waters of Columbia River, Oregon and Wash., 419; removing sunken vessels or craft obstructing or endangering navigation, examinations and surveys, 420.

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS 421

SUPERVISION OF THE HARBOR OF NEW YORK 422

MISSISSIPPI RIVER COMMISSION 422

MISSOURI RIVER COMMISSION 423

HARBOR LINES 423

Lubec, Me., Kennebec River at Bath, Me., Boston Harbor, Mass., New York Harbor and its adjacent waters, 424; Philadelphia, Pa., New Castle, Del., St. Augustine Harbor, Fla., 425; Duluth Harbor, Bay of St. Louis, Superior Bay and adjajent waters, Minn. and Wis., Portage Lake, Mich., Chicago Harbor, Ill., San Francisco Harbor and adjacent waters, Cal., San Pedro, Wilmington Harbor, Cal., 426; Humboldt Bay, Cal., Astoria Harbor, Oregon, 427.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

(1) Bridge of Winona and Southwestern Railway Company across Mississippi River at Winona, Minn.; (2) bridge across Powow River, between the towns of Amesbury and Salisbury, Mass., 427; (3) bridge of Clinton and Illinois Bridge Company across Mississippi River near Clinton, Iowa; (4) bridge of Leavenworth and Platte County Bridge Company across Missouri River between Leavenworth, Kans., and Platte County, Mo., 428; (5) bridge of Charleston and South Side Bridge Company across Great Kanawha River at Charlestown, W. Va.; (6) bridge of Oregon Railway Extensions Company across Columbia River near Vancouver, Wash.; (7) bridge of The South Bound Railroad Company across Savannah River near Sister Ferry, Effingham County, Ga.; (8) bridge of Houston, Central Arkansas and Northern Railroad Company across Little River, La.; (9) bridge of Wrightsville and Tennille (Tennville) Railroad Company across Oconee River near Dublin, Ga., 429; (10) bridge of Houston, Central Arkansas and Northern Railroad Company across Ouachita River near Columbia, La.; (11) bridge of Kansas City Terminal Railway Company across Missouri River near Quindaro, Kans.; (12) bridge of city of St. Paul, Minn., across Mississippi River at St. Paul, Minn.; (13) bridge of Cable City Bridge Construction Company across Arkansas River at Dardanelle, Ark.; (14) bridge of Houston, Central Arkansas and Northern Railroad Company across Red River at Upper Falls, near Alexandria, La.; (15) bridge of Macon, Dublin and Savannah Railroad Company across Oconee River at Dublin, Ga.; (16) bridges of Tacoma, Olympia and Grays Harbor Railroad Company across Chehalis River between Aberdeen and Cosmopolis, Wash., and across Johns River near its confluence with Grays Harbor, Wash., 430; (17) bridges of Norfolk and Western Railroad Company across Tug Fork of Big Sandy River, 91 and 95½ miles above Catlettsburg, Ky.; (18) bridge of Port View Bridge Company across Youghiogheny River at McKeesport, Pa.; (19) bridge of Inter-State Bridge and Street Railway Company across Missouri River between Council Bluffs, Iowa, and East Omaha, Nebr.; (20) bridge of Northern Pacific and Puget Sound Shore Railroad Company across Duwamish (D'Wamish) River near Seattle, Wash.; (21) bridge of Spokane

and Palouse Railway Company across Clearwater River, about 11 miles above Lewiston, Idaho; (22) bridge of Allegheny Bridge Company across Allegheny River, at Sixth street, Pittsburg, Pa.; (23) bridge of Messrs. Frederick W. Dickinson *et al.* across channel separating Little Island from mainland at Osterville, in town of Barnstable, Mass.; (24) bridge of city of Winona, Minn., across Mississippi River at Winona, Minn., 431; (25) bridge of Missouri River and Land Improvement and Construction Company across Missouri River near mouth of Kansas River; (26) bridge of Coos Bay, Roseburg and Eastern Railroad and Navigation Company across Coal Bank Slough, in Coos County, Oregon; (27) bridge of St. Clair, Madison and St. Louis Belt Railroad Company across Mississippi River at Alton, Ill.; (28) temporary and permanent bridges of Chicago and North-Western Railway Company across North Branch of Chicago River near Kinzie street, Chicago, Ill.; (29) bridge of The Upper Bridge Company across Monongahela River near Pittsburg, Pa.; (30) bridge of Chicago and North Michigan Railroad Company across Pine Lake, near Charlevoix, Mich.; (31) bridge of commissioners of public parks of the city of New York across Harlem River at 155th street and McComb Dam Road, New York City, 432; (32) bridge of North River Bridge Company across Hudson River at New York City, 433.

BRIDGES OBSTRUCTING NAVIGATION.

(1) Bridge across Ashley River, S. C.; (2) bridge across Swinomish Slough, Wash., 433; (3) bridge across Green River (below Lock No. 1), at Spottsville, Ky.; (4) bridge across Muskingum River, between Marietta and Harmar, Ohio; (5) bridge across Muskingum River, between Taylorsville and Duncan Falls, Ohio; (6) bridge across canal of Muskingum River at foot of Main street, Zanesville, Ohio; (7) bridge across Bayou Plaquemine, La., 434; (8) bridge across channel leading to Back Cove, Portland Harbor, Me.; (9) bridge across Savannah River below Augusta, Ga.; (10) bridge across Tennessee River at Florence, Ala.; (11) bridge across Little Tennessee River, near Niles Ferry, Tenn.; (12) bridge across Spuyten Duyvil Creek, N. Y.; (13) bridge across Trout Creek, Fla., 435; (14) bridge across Chicago River at Canal street, Chicago, Ill.; (15) bridge across Kentucky River at Frankfort, Ky., 436.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS..... 436

MISCELLANEOUS.

WASHINGTON AQUEDUCT.

IN THE CHARGE OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS—

Washington Aquedact, 436; water supply, District of Columbia, 441; increasing the water supply of Washington, D. C., 442; erection of fishways at Great Falls, 443.

PUBLIC BUILDINGS AND GROUNDS AND WASHINGTON MONUMENT, DISTRICT OF COLUMBIA.

IN THE CHARGE OF COL. O. H. ERNST, MAJOR, CORPS OF ENGINEERS 444

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

SURVEY at Marquette Harbor, Mich., 445.

PRINTING AND DISTRIBUTION OF CHARTS OF THE NORTHERN AND NORTHWESTERN LAKES 445

CONSTRUCTION AND IMPROVEMENT OF ROADS AND BRIDGES IN YELLOWSTONE NATIONAL PARK.

IN THE CHARGE OF MAJ. WILLIAM A. JONES, CORPS OF ENGINEERS 447

MILITARY AND OTHER MAPS..... 449

RECONNAISSANCES AND EXPLORATIONS.

OFFICERS on duty at headquarters of military divisions and departments, operations in Division of the Missouri, 449; operations in Department of the Columbia, Department of the Platte, Division of the Pacific, 450.

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS 450

OFFICE OF THE CHIEF OF ENGINEERS.

OFFICERS in charge of divisions, 451.

STATEMENT SHOWING RANK AND DUTIES OF OFFICERS OF THE CORPS OF ENGINEERS DURING THE FISCAL YEAR ENDING JUNE 30, 1891 .. 453

LAWS AFFECTING THE CORPS OF ENGINEERS, FIFTY-FIRST CONGRESS, SECOND SESSION, 1890–'91 477

FORTIFICATIONS, ETC.

APPENDIX No. 1.

REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

PROTECTION of site of Fort Niagara, N. Y., 517.

APPENDIX No. 2.

REPORT OF COL. D. C. HOUSTON, CORPS OF ENGINEERS.

IMPROVEMENTS.—Sea wall and embankment at Davids Island, New York Harbor, 521; sea walls on Governors Island, New York Harbor, 524.

APPENDIX No. 3.

REPORT OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Beach protection at Fort Monroe, Va., 529; water supply at Fort Monroe, Va., 530; sewerage system at Fort Monroe, Va., 531.

APPENDIX No. 4.

REPORT OF CAPT. W. M. BLACK, CORPS OF ENGINEERS.

REPAIR and preservation of Fort Marion, St. Augustine, Fla., 533.

APPENDIX No. 5.

REPORT OF LIEUT. COL. W. R. KING, CORPS OF ENGINEERS.

POST of Willets Point, N. Y., 537; United States Engineer School, 539; Battalion of Engineers, 540; Engineer Depot, 547; experiments, 550; statement of funds, 551; estimates, 553. Appendixes: B, programme of study and instruction for winter season, 553; C, programme of study and instruction for summer season, 556; D, tests of explosives, 559; E, tests of building materials, 565.

RIVERS AND HARBORS, ETC.

APPENDIX A.

REPORT OF LIEUT. COL. JARED A. SMITH, CORPS OF ENGINEERS.

IMPROVEMENTS.—St. Croix River, Me., 570; Lubec Channel, Me., 571; Mooseabec Bar, Me., 572; Pleasant River, Me., 573; Narraguagus River, Me., 574; breakwater from Mount Desert to Porcupine Island, Me., 576; Bagaduce River, Me., 578; Penobscot River, Me., 579; Belfast Harbor, Me., 586; Camden Harbor, Me., 587; Rockport Harbor, Me., 588; Rockland Harbor, Me., 589; Kennebec River, Me., 590; Harraseeket River, Me., 594; Portland Harbor, Me., 595; channel in Back Cove, Portland, Me., 597; breakwater at mouth of Saco River, Me., 598; Saco River, Me., 599; Kennebunk River, Me., 601; York Harbor, Me., 602; Portsmouth Harbor, N. H., 604; Bellamy River, N. H., 605; Cocheco River, N. H., 607; harbor of refuge at Little Harbor, N. H., 608; removing sunken vessels or craft obstructing or endangering navigation, 609.

EXAMINATIONS.—Harbor of Blue Hill, Me., 611; Pepperell Cove, Me., 614; Lubec Channel, Me., 616; Sullivan Falls, Me., 619.

HARBOR LINES.—Establishment of harbor lines at Lubec, Me., 621; establishment of harbor lines in Kennebec River at Bath, Me., 622.

APPENDIX B.

REPORT OF LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Newburyport Harbor, Mass., 626; Merrimac River, Mass., 628; Powow River, Mass., 630; Ipswich River, Mass., 631; harbor of refuge, Sandy Bay, Cape Ann, Mass., 632; Gloucester Harbor, Mass., 635; Manchester Harbor, Mass., 638; Salem Harbor, Mass., 639; Lynn Harbor, Mass., 641; Winthrop Harbor, Mass., 644; Boston Harbor, Mass., 645; Weymouth River, Mass., 655; Hingham Harbor, Mass., 656; Scituate Harbor, Mass., 658; Plymouth Harbor, Mass., 660; Wellfleet Harbor, Mass., 663; Provincetown Harbor, Mass., 665, Chatham Harbor, Mass., 667.

EXAMINATIONS AND SURVEYS.—North River, Salem, Mass., 668; shoals at the mouth of North River, Mass., 670; Mystic and Malden rivers, Mass., 672; Essex River, Mass., 676; Town River, Mass., 679; Weymouth Back River, Mass., 682; Kingston Harbor, Mass., 685.

HARBOR LINES.—Establishment of harbor lines in Boston Harbor, Mass., 688.

APPENDIX C.

REPORT OF MAJ. W. R. LIVERMORE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor of refuge at Hyannis, Mass., 694; harbor of refuge at Nantucket, Mass. 696; Marthas Vineyard, inner harbor at Edgartown, Mass., 698; Vineyard Haven Harbor, Mass., 700; Wareham Harbor, Mass., 701; New Bedford Harbor, Mass., 704; Westport Harbor, Mass., 706; Taunton River, Mass., 707; Pawtucket River, R. I., 709; Providence River and Narragansett Bay, R. I., 712; removal of Green Jacket Shoal, Providence River, R. I., 715; Greenwich Bay, R. I., 716; cove and water way near Coaster Harbor Island, R. I., 718; Newport Harbor, R. I., 719; harbor of refuge at Point Judith, R. I., 722; harbor of refuge at Block Island, R. I., 723; Pawcatuck River, R. I. and Conn., 726; harbor of refuge at Stonington, Conn., 728; removing sunken vessels or craft obstructing or endangering navigation, 731.

EXAMINATIONS.—Narragansett Bay Channel, R. I., between Starve Goat Island and the mainland, 733; Watch Hill Cove, R. I., 735; Newport Harbor, R. I., south of Goat Island, 736.

APPENDIX D.

REPORT OF COL. D. C. HOUSTON, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mystic River, Conn., 740; Thames River, Conn., 742; New London Harbor, Conn., 746; Connecticut River, Mass. and Conn., 748; harbor of refuge at Duck Island Harbor, Conn., 757; Clinton Harbor, Conn., 759; New Haven Harbor, Conn., 761; breakwater at New Haven, Conn., 766; Milford Harbor, Conn., 770; Housatonic River, Conn., 773; Bridgeport Harbor, Conn., 778; Black Rock Harbor, Conn., 784; Norwalk Harbor, Conn., 786; harbor at Wilson Point, Conn., 789; Five Mile River Harbor, Conn., 792; Stamford Harbor, Conn., 795; Port Chester Harbor, N. Y., 797; Larchmont Harbor, N. Y., 800; Echo Harbor, New Rochelle, N. Y., 802; New Rochelle Harbor, N. Y., 804; East Chester Creek, N. Y., 806; Greenport Harbor, N. Y., 811; Port Jefferson Harbor, N. Y., 814; Huntington Harbor, N. Y., 817; Glen Cove Harbor, N. Y., 820; Flushing Bay, N. Y., 822; Patchogue River, N. Y., 825; Browns Creek, Sayville, N. Y., 828.

EXAMINATIONS AND SURVEYS.—Stony Creek River at Stony Creek, Conn., 831; Shaw Cove, New London Harbor, Conn., 833; Connecticut River, below Hartford, Conn., 836; Saugatuck River, Conn., 840; Mattituck Bay, N. Y., 843; Stamford Harbor, Conn., 848; Cos Cob or Miamus River, Conn., 852; Peconic River, N. Y., 855; Sag Harbor, N. Y., 859.

APPENDIX E.

REPORT OF LIEUT. COL. G. L. GILLESPIE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Hudson River, N. Y., 864; harbor at Saugerties, N. Y., 879; harbor at Rondout, N. Y., 882; Wappinger Creek, N. Y., 885; Harlem River, N. Y., 886; removing obstructions in East River and Hell Gate, N, Y., 899; Newtown Creek, N. Y., 906; Buttermilk Channel, New York Harbor, 911; Gowanus Bay, N. Y., 914; New York Harbor, N. Y., 922; Raritan Bay, N. J., 931; removing sunken vessels or craft obstructing or endangering navigation, 937.

EXAMINATIONS AND SURVEYS.—Buttermilk and Gowanus Bay Channels, New York Harbor, 937; Bay Ridge Channel, N. Y., 940; Champlin Creek, N. Y., 942; Hudson River and Moodna River (Murderers Creek) at Cornwall, N. Y., 944; Bronx River, N. Y., 949; Westchester Creek, N. Y., 954.

HARBOR LINES.—Establishment of harbor lines in New York Harbor and its adjacent waters, 958.

PART II.

APPENDIX F.

REPORT OF CAPT. THOS. L. CASEY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Sumpawanus Inlet, N. Y., 978; Canarsie Bay, N. Y., 980; Sheepshead Bay, N. Y., 982; Arthur Kill, N. Y. and N. J., 983; channel between Staten Island and New Jersey, 986; Passaic River, N. J., 988; Elizabeth River, N. J., 993; Rahway River, N. J., 995; Raritan River, N. J., 996; South River, N. J., 999; Keyport Harbor, N. J., 1001; Mattawan Creek, N. J., 1003; Shoal Harbor and Compton Creek, N. J., 1004; Shrewsbury River, N. J., 1007; Manasquan (Squan) River, N. J., 1010; removing sunken vessels or craft obstructing or endangering navigation, 1013.

EXAMINATIONS AND SURVEY.—Princess Bay, Staten Island, N. Y., 1013; Hackensack River, N. J., 1016.

APPENDIX G.

REPORT OF MAJ. C. W. RAYMOND, CORPS OF ENGINEERS.

IMPROVEMENTS.—Delaware River, Pa. and N. J., 1022; harbor between Philadelphia Pa., and Camden, N. J., 1029; Schuylkill River, Pa., 1069; ice-harbor at Marcus Hook, Pa., 1072; ice-harbor at head of Delaware Bay, Del., 1072; construction of iron pier in Delaware Bay, near Lewes, Del., 1073; harbor at Delaware Breakwater, Del., 1075; Rancocas River, N. J., 1084; Alloway Creek, N. J., 1086; Maurice River, N. J., 1088; removal of wrecks from Delaware Bay and River, 1090; removing sunken vessels or craft obstructing or endangering navigation, 1090.

EXAMINATIONS AND SURVEYS.—Shark River, N. J., 1092; sound between Barnegat Bay and Great Egg Harbor Bay, N. J., 1093; Little Egg Harbor Bay and Inlet, including Great Bay, N. J., 1095; thoroughfare from Cape May to the Great Bay north of Atlantic City, N. J., 1097; Cape May City, N. J., 1099; Pensauken Creek, N. J., 1100; West Branch of Susquehanna River, Pa., 1102; Toms River, N. J., 1114; Goshen Creek, N. J., 1116; harbor of refuge near mouth of Delaware Bay, 1120.
HARBOR LINES.—Establishment of harbor lines in port of Philadelphia, 1121.

APPENDIX H.

REPORT OF WM. F. SMITH, UNITED STATES AGENT, MAJOR OF ENGINEERS, U. S. ARMY, RETIRED.

IMPROVEMENTS.—Wilmington Harbor, Del., 1136; ice-harbor at New Castle, Del., 1160; Appoquinnimink River, Del., 1161; Smyrna River, Del., 1162; St. Jones River, Del., 1165; Mispillion Creek, Del., 1166; Broadkiln River, Del., 1167; inland water way from Chincoteague Bay, Va., to Delaware Bay, at or near Lewes, Del., 1168; Susquehanna River, above and below Havre de Grace, Md., 1181; North East River, Md., 1182; Elk River, Md., 1184; Fairlee Creek, Md., 1186; Chester River, Md., from Crumpton to Jones Landing, 1188; Choptank River, Md., 1189; Cambridge Harbor, Md., 1191; Wicomico River, Md., 1193; Manokin River, Md., 1195; Onancock Harbor, Va., 1197; harbor at Cape Charles City, Va., and approaches by Chenton (Cherrystone) Inlet, 1199; removing sunken vessels or craft obstructing or endangering navigation, 1201.
EXAMINATIONS AND SURVEYS.—Linchester River, Md., 1202; Northwest Fork of Nanticoke River, Md., 1204; Tangier Harbor, Va., 1207; Broad Creek River, Del., 1209; Turner Creek, Md., 1211; La Trappe River, Md., 1215; Warwick River, Md., 1218; Broad Creek, Md., 1221.
HARBOR LINES.—Establishment of harbor lines at New Castle, Del., 1225.

APPENDIX I.

REPORT OF COL. WM. P. CRAIGHILL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Patapsco River and channel to Baltimore, Md., 1227; James River, Va., 1234.
EXAMINATION.—Patapsco River, Md., from the Craighill Channel to the sugar refinery wharves, Curtis Bay, 1243.

APPENDIX J.

REPORT OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Potomac River at Washington, D. C., 1246; Potomac River at Mt. Vernon, Va., 1252; Occoquan Creek, Va., 1253; Aquia Creek, Va., 1255; harbor at Breton Bay, Md., 1258; Nomini Creek, Va., 1259; Patuxent River, Md., 1262; Rappahannock River, Va., 1264; Urbana Creek, Va., 1268; York River, Va., 1270; Mattaponi River, Va., 1273; Pamunkey River, Va., 1275.
EXAMINATIONS.—St. Leonard Creek, Md., 1277; St. Jerome Bay, Md., 1278; Piscataway Creek, Md., 1279; Newport Creek, head of Wicomico River, Md., 1281; Smith Creek, Md., 1282; Nandua Creek, Va., 1283; Potomac Creek, Va., 1285; Upper Machodoc Creek, Va., 1286; Great Wicomico River, Va., 1288; Crane Creek, Va., 1289; Piscataway Creek, Va., 1289.

APPENDIX K.

REPORT OF CAPT. G. J. FIEBEGER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor of Norfolk and its approaches, Va., 1291; approach to Norfolk Harbor and the United States navy-yard at Norfolk, Va., 1296; Hampton Creek and Bar, Va., 1297; Nansemond River, Va., 1298; Chickahominy River, Va., 1299; Appomattox River, Va., 1300; inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C., through Currituck Sound, 1302; North Landing River, Va. and N. C., 1304; Currituck Sound, Coanjok Bay, and North River Bar, N. C., 1305.

EXAMINATIONS.—Chickahominy River, from Holly Landing to Long Bridge, Va., 1305; western branch of Elizabeth River, Va., 1307; water way to connect Lynn Haven Bay with eastern branch of Elizabeth River, Va., 1310; Nottoway River, from mouth of river to Courtland, Va., 1315; North-West River, N. C., up to Moyock, 1321; West Neck River, to and beyond Dozier Bridge, Va., 1324.

APPENDIX L.

REPORT OF CAPT. W. H. BIXBY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Staunton River, Va., 1328; Roanoke River, Va. and N. C., 1330; Pasquotank River, N. C., 1335; Mackey Creek, N. C., 1339; Ocracoke Inlet, N. C., 1341; Fishing Creek, N. C., 1345; Pamlico and Tar rivers, N. C., 1347; Contentnia Creek, N. C., 1351; Trent River, N. C., 1355; Neuse River, N. C., 1358; inland water way between New Berne and Beaufort, N. C., 1363; harbor at Beaufort, N. C., 1367; inland water way between Beaufort Harbor and New River, N. C., 1372; water way between New River and Swansboro, N. C., 1376; New River, N. C., 1379; North East (Cape Fear) River, N. C., 1383; Black River, N. C., 1387; Cape Fear River, N. C., above Wilmington, 1390; Cape Fear River, N. C., at and below Wilmington, 1394; Lockwoods Folly River, N. C., 1402; Yadkin River, N. C., 1404; harbor at Georgetown, S. C., 1408; Winyaw Bay, S. C., 1411; removing sunken vessels or craft obstructing or endangering navigation, 1417.

EXAMINATIONS.—Water way from Pungo River to Sladesville, N. C., 1418; water way between Pamlico River and Bay River, N. C., 1421; Drum Inlet, N. C., 1425; harbor of Washington, Pamlico River, N. C,. 1429; White Oak River, from Roberts Landing to Collins Crossing, N. C., 1434; Black River, from Kingstree to its mouth, S. C., 1435.

APPENDIX M.

REPORT OF CAPT. FREDERIC V. ABBOT, CORPS OF ENGINEERS.

IMPROVEMENTS.—Waccamaw River, N. C. and S, C., 1442; Lumber River, N. C. and S. C.. 1445; Little Pedee River, S. C., 1448; Great Pedee River, S. C., 1450; Clark River, S. C., 1453; Mingo Creek, S. C., 1455; Santee River, S. C., 1458; Wateree River, S. C., 1462; Congaree River, S. C., 1464; harbor at Charleston, S. C., 1467; Ashley River, S. C., 1476; Wappoo Cut, S. C., 1477; Edisto River, S. C., 1480; Salkahatchie River, S. C., 1482; Beaufort River, S. C., 1485; removing sunken vessels or craft obstructing or endangering navigation, 1487.

EXAMINATION.—Wateree River, S. C., 1487.

PART III.

APPENDIX N.

REPORT OF CAPTAIN O. M. CARTER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Savannah River and Harbor, Ga., 1491; Savannah River, Ga., 1519; Darien Harbor, Ga., 1528; Altamaha River, Ga., 1531; Oconee River, Ga., 1536; Ocmulgee River, Ga., 1543; Brunswick Harbor, Ga., 1550; Jekyl Creek, Ga., 1556; Cumberland Sound, Ga., and Fla., 1559; removing sunken vessels or craft obstructing or endangering navigation, 1602.

EXAMINATION.—Yellow River, Ga., 1606.

APPENDIX O.

REPORT OF CAPT. W. M. BLACK, CORPS OF ENGINEERS.

IMPROVEMENTS.—St. Johns River, Fla., 1612; Ocklawaha River, Fla., 1620; Volusia Bar, Fla., 1627; St. Augustine Harbor, Fla., 1630; northwest entrance, Key West Harbor, Fla., 1640; Caloosahatchee River, Fla., 1643; channel of Charlotte Harbor and Pease Creek, Fla., 1646; Sarasota Bay, Fla., 1651; Manatee River, Fla., 1653; Tampa Bay, Fla., 1655; Withlacoochee River, Fla., 1659; harbor at Cedar Keys, Fla., 1661; Suwanee River, Fla., 1663.

EXAMINATIONS.—St. Johns River, Fla., from Jacksonville to Sanford, and the upper part of St. Johns River, from Lake Monroe southward, 1666; deep-sea channel at St. Augustine, Fla., 1671; Indian River, Fla., between Titusville and Jupiter Inlet, 1673; channel north and west of Cedar Keys, Fla., 1676; Pease River, Fla., 1678; Charlotte Harbor, Fla., 1681.
HARBOR LINES.—Establishment of harbor lines in St. Augustine Harbor, Fla., 1685.

APPENDIX P.

REPORT OF CAPT. PHILIP M. PRICE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Apalachicola Bay, Fla., 1694; Apalachicola River, Fla., including Lee Slough, 1696; Flint River, Ga., 1698; Chattahoochee River, Ga. and Ala., 1702; La Grange Bayou and Holmes River, Fla., 1704; Choctawhatchee River, Fla. and Ala., 1707; harbor at Pensacola, Fla., 1710; Escambia and Conecuh rivers, Fla. and Ala., 1735; Alabama River, Ala., 1738; Tallapoosa River, Ala., 1741; Coosa River, Ga. and Ala., 1743; operating and care of canals and other works of navigation on Coosa River, Ga. and Ala., 1753; Cahaba River, Ala., 1754.
EXAMINATIONS.—Chattahoochee River, Ga. and Ala., between West Point and Franklin, 1756; Alabama River, Ala., 1761.

APPENDIX Q.

REPORT OF MAJ. A. N. DAMRELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mobile Harbor, Ala., 1771; Warrior and Tombigbee rivers, Ala. and Miss., 1776; Black Warrior River, Ala., from Tuscaloosa to Daniels Creek, 1784; Noxubee River, Miss., 1787; Pascagoula River, Miss., 1788; Chickasahay River, Miss., 1791; Bluff Creek, Miss., 1792; Leaf River, Miss., 1792; harbor at Biloxi Bay, Miss., 1793; Pearl River, Miss., below Jackson, 1795; Pearl River, Miss., between Jackson and Carthage, 1797; Pearl River, Miss., between Edinburg and Carthage, 1799; Bogue Chitto, La., 1800.
EXAMINATION.—Sucarnochee River, Ala., 1800.

APPENDIX R.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

INSPECTION of the improvement of the South Pass of the Mississippi River, 1805.

APPENDIX S.

REPORT OF MAJ. JAMES B. QUINN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Chefuncte River and Bogue Falia, La., 1818; Tickfaw River and its tributaries, La., 1819; Amite River and Bayou Manchac, La., 1820; Bayou La Fourche, La., 1821; Bayou Terrebonne, La., 1823; Bayou Plaquemine, La., 1824; Bayou Courtableau, La., 1826; Bayou Teche, La., 1828; mouth and passes of Calcasieu River, La., 1829; harbor at Sabine Pass, Tex., 1831; Sabine River, Tex., 1835; Neches River, Tex., 1836; removing sunken vessels or craft obstructing or endangering navigation, 1837.
EXAMINATIONS AND SURVEY.—Bayou Carlin, La., 1838; shoals on Lake Pontchartrain, La., near the Rigolets, 1839; Bayou Chevreuil and Bayou Tigre, La., 1841; Bayou Terre Bonne, La., from Houma to Thibodeaux, 1843; Bayou Black to connect with Terre Bonne, La., 1846; Berwick Bay, La., 1847; Bayou Cocodrie, La., 1849; Bayou Black, La., for connection between Calcasieu Lake and Sabine Lake, 1850; Bayou Teche, La., from Saint Martinsville to Port Barre, 1852; Bayou Des Glaises, La., 1854; Bayou Vermillion, La., 1855; Mermenton River and tributaries, La., 1858.

APPENDIX T.

REPORT OF LIEUT. JOHN MILLIS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Securing mouth of Bayou Plaquemine, La., from further caving, 1867; removing sunken vessels or craft obstructing or endangering navigation of New Orleans Harbor, La., 1869.

APPENDIX U.

REPORT OF MAJ. CHAS. J. ALLEN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Entrance to Galveston Harbor, Tex., 1871; ship channel in Galveston Bay, Tex., 1906; Trinity River, Tex., 1918; Cedar Bayou, Tex., 1922; Buffalo Bayou, Tex., 1924; harbor at Brazos Santiago, Tex., 1930.
EXAMINATIONS.—Mouth of Double Bayou, Chambers County, Tex., 1933; Trinity River, Tex., from its mouth to Dallas, 1936; Colorado River, Tex., 1939; Aransas Bay, Tex., to remove Half-Moon Reef; and St. Charles Bay, Tex., 1942.

PART IV.

APPENDIX V.

REPORT OF CAPT. J. H. WILLARD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Red River, La. and Ark., 1946; Red River above Fulton, Ark., 1961; Ouachita and Black rivers, Ark. and La., 1964; Ouachita River above Camden, Ark., 1975; Bayou D'Arbonne, La., 1980; Bayou Bartholomew, La. and Ark., 1982; Bayou Bœuf (Bœuf River), La., 1985; Tensas River and Bayou Maçon, La., 1989; Bayous Rondeway and Vidal, La., 1992; Big Black River, Miss., 1993; Yazoo River, Miss., 1996; Tchula Lake, Miss., 2001; Tallahatchee River, Miss., 2003; Steele Bayou and Washington Bayou, Miss., 2005; Big Sunflower River, Miss., 2007; Big Hatchee River, Tenn., 2010; Forked Deer River, Tenn., 2012; water gauges on Mississippi River and its principal tributaries, 2014; survey of Cypress Bayou and the lakes between Jefferson, Tex., and Shreveport, La., 2021.
EXAMINATIONS.—Cane River, La., 2022; Bayou Castor, La., 2028.

APPENDIX W.

REPORT OF CAPT. H. S. TABER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Removing obstructions in Arkansas River, Ark., Ind. Ter., and Kans., 2033; Arkansas River, Ark., Ind. Ter., and Kans., 2037; Fourche Le Fevre River, Ark., 2044; Petit Jean River, Ark., 2046; White River, Ark., 2048; Cache River, Ark., 2051; Little Red River, Ark., 2053; Black River, Ark. and Mo., 2055; Black River, Mo., 2058; St. Francis River, Ark., 2059; St. Francis River, Mo., 2062; Little River, Mo. and Ark., 2064.
EXAMINATIONS.—Current River, from Van Buren, Mo., to its mouth, 2065.

APPENDIX X.

REPORT OF CAPT. S. W. ROESSLER, CORPS OF ENGINEERS.

EXAMINATION.—Mississippi River from high-water mark, Lake County, Tenn., to high-water mark, Fulton County, Ky., north and west of Reelfoot Lake, 2073.

APPENDIX Y.

REPORT OF MAJ. A. M. MILLER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Removing snags and wrecks from Mississippi River, 2079; Mississippi River, between the Ohio and Illinois rivers, 2087; harbor at Saint Louis, Mo., 2109; Gasconade River, Mo., 2112; Osage River, Mo., 2114; Kaskaskia River, Ill., 2118.

APPENDIX Z.

REPORT OF MAJ. E. H. RUFFNER, CORPS OF ENGINEERS.

IMPROVEMENT.—Mississippi River, between Des Moines Rapids and mouth of Illinois River, 2119.
EXAMINATION.—Mississippi River at Warsaw, Ill., 2134.

APPENDIX A A.

REPORT OF MAJ. A. MACKENZIE, CORPS OF ENGINEERS.

IMPROVEMENTS.—Operating snag boats and dredge boats on Upper Mississippi River, 2137; Mississippi River, between Minneapolis and Des Moines Rapids, 2147; Des Moines Rapids, Mississippi River, 2172; operating and care of Des Moines Rapids Canal and dry dock, 2174.
EXAMINATIONS AND SURVEY.—Slough at Hamilton, Ill., 2185; Mississippi River at and above Clinton, Iowa, 2187.

APPENDIX B B.

REPORT OF MAJ. W. A. JONES, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mississippi River above Falls of St. Anthony, Minn., 2192; reservoirs at headwaters of Mississippi River, 2196; Chippewa River, including Yellow Banks, Wis., 2201; St. Croix River, Wis. and Minn., 2203; Minnesota River, Minn., 2207; Red River of the North. Minn. and N. Dak., 2210; surveys for reservoirs at the sources of Mississippi, St. Croix, Chippewa, and Wisconsin rivers 2214; gauging Mississippi River at or near St. Paul, Minn., 2214.
EXAMINATIONS.—Harbor at Hudson, Wis., 2218; Red River of the North at Goose Rapids, N. Dak. and Minn., 2220; Creel Bay, Totten Bay, and Minnewauken Shoals, in Devil Lake, N. Dak., 2223.

APPENDIX C C.

REPORT OF LIEUT. COL. CHAS. R. SUTER, CORPS OF ENGINEERS.

EXAMINATION.—Missouri River, from the old mouth of Platte River, Little Point, to a point opposite Leavenworth; and at Weston, Mo., 2229.

APPENDIX D D.

REPORT OF CAPT. CHAS. F. POWELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Missouri River between the Great Falls, Mont., and Sioux City, Iowa, 2232; Yellowstone River, Mont. and N. Dak., 2236.
EXAMINATIONS AND SURVEY.—Tongue River, Mont., 2237; Yellowstone River, Mont., 2239; Missouri River between Sioux City, Iowa, and Fort Benton, Mont., 2242.

APPENDIX E E.

REPORT OF LIEUT. COL. J. W. BARLOW, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tennessee River, above Chattanooga, Tenn., and below Bee Tree Shoals, Ala., 2252; Hiawassee River, Tenn., 2259; French Broad River, Tenn., 2261; Clinch River, Tenn., 2264; Cumberland River, Tenn. and Ky., 2267; Caney Fork River, Tenn., 2284; South Fork of Cumberland River, Ky., 2286.
EXAMINATIONS AND SURVEY.—Little Pigeon River, Tenn., from mouth to Sevierville, 2287; harbor of Smithland, Ky., 2289; Obion River, Tenn., 2292.

APPENDIX F F.

REPORT OF LIEUT. GEO. W. GOETHALS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tennessee River between Chattanooga, Tenn., and foot of Bee Tree Shoals, Ala., 2303; operating and care of Muscle Shoals Canal, Tennessee River, 2322.
EXAMINATION.—Mouth of Gunter Creek at Guntersville, Ala., 2325.

APPENDIX G G.

REPORT OF LIEUT. COL. WM. E. MERRILL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Ohio River, 2328; operating snag boats on Ohio River, 2349; operating and care of Davis Island Dam, Ohio River, 2350; movable dam in Ohio River near mouth of Beaver River, Pa., 2354; Monongahela River, W. Va. and Pa., 2355; operating and care of locks and dams Nos. 8 and 9, Monongahela River, 2357; purchase of Lock and Dam No. 7, Monongahela River, 2359; purchase of Lock and Dam No. 6, Monongahela River, 2360; Cheat River, W. Va., 2361; Allegheny River, Pa., 2363; dam at Herr Island, Allegheny River, 2366; ice-harbor at mouth of Muskingum River, Ohio, 2367; Muskingum River, Ohio, 2369; operating and care of locks and dams on Muskingum River, Ohio, 2369.
EXAMINATIONS.—Harbor of Owensboro, Ky., on the Ohio River, 2380; Tionesta Creek, Pa., 2381; Ohio River, between mouth of Green River, Ky., and Evansville, Ind., 2382.

APPENDIX H H.

REPORT OF MAJ. G. J. LYDECKER, CORPS OF ENGINEERS.

IMPROVEMENTS.—Falls of the Ohio River, at Louisville, Ky., 2387; Indiana Chute, Falls of the Ohio River, 2393; operating and care of Louisville and Portland Canal, Ky., 2394; Wabash River, Ind. and Ill., 2402; White River, Ind., 2409.
EXAMINATION.—Wabash River, Ind., from Terre Haute to La Fayette, 2411.

APPENDIX I I.

REPORT OF COL. WM. P. CRAIGHILL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Great Kanawha River, W. Va., 2413; operating and care of locks and dams on Great Kanawha River, W. Va., 2425; Elk River, W. Va., 2427; Gauley River, W. Va., 2428; New River, Va. and W. Va., 2430.
EXAMINATION.—Elk River, W. Va., 2433.

APPENDIX J J.

REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Tradewater River, Ky., 2438; operating and keeping in repair locks and dams on Green and Barren rivers, Ky., 2439; Rough River, Ky., 2446; Kentucky River, Ky., 2449; operating and keeping in repair locks and dams on Kentucky River, Ky., 2455; Licking River, Ky., from Farmers to West Liberty, 2462; Big Sandy River, W. Va. and Ky., 2463; Levisa Fork of Big Sandy River, Ky., 2466; Tug Fork of Big Sandy River, W. Va. and Ky., 2467; Guyandotte River, W. Va., 2469; Little Kanawha River, W. Va., 2471; Buckhannon River, W. Va., 2474.
EXAMINATIONS.—Big Barren River, Ky., above Bowling Green, 2474; Russel Fork of the Big Sandy River, Ky., 2476; Green River, Ky., above mouth of Big Barren River, 2478.

APPENDIX K K.

REPORT OF CAPT. W. L. FISK, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor at Grand Marais, Minn., 2484; harbor at Agate Bay, Minn., 2486; harbor at Duluth, Minn., 2488; harbor at Superior Bay and St. Louis Bay, Wis., 2495; Minnesota Point at Superior, Wis., 2499; harbor at Ashland, Wis., 2500; harbor at Ontonagon, Mich., 2502; Eagle Harbor, Mich., 2505; harbor at Marquette, Mich., 2505; harbor of refuge at Grand Marais, Mich., 2509.
EXAMINATION.—Allouez Bay and Nemadji River, Wis., 2512.
HARBOR LINES.—Establishment of harbor lines at Duluth, Minn., bay of St. Louis, Superior Bay, and the adjacent waters, Minn. and Wis., 2515; establishment of harbor lines in Portage Lake, Mich., 2519; resurvey and relocation of harbor line in Portage Lake, Mich., 2522.

APPENDIX L L.

REPORT OF MAJ. CHAS. E. L. B. DAVIS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Manistique Harbor, Mich., 2523; Cedar River Harbor, Mich., 2525; Menomonee Harbor, Mich. and Wis., 2527; Menomonee River, Mich. and Wis., 2528; Oconto Harbor, Wis., 2531; Pensaukee Harbor, Wis., 2533; Green Bay Harbor, Wis., 2533; harbor of refuge at entrance of Sturgeon Bay Canal, Wis., 2536; Ahnapee Harbor, Wis., 2538; Kewaunee Harbor, Wis., 2540; Two Rivers Harbor, Wis., 2543; Manitowoc Harbor, Wis., 2545; Sheboygan Harbor, Wis., 2549; Port Washington Harbor, Wis., 2551; harbor of refuge at Milwaukee Bay, Wis., 2553; Milwaukee Harbor, Wis., 2560; Racine Harbor, Wis., 2562; Kenosha Harbor, Wis., 2565; Waukegan Harbor, Ill., 2568; Fox and Wisconsin rivers, Wis., 2572; operating and care of locks and dams on Fox River, Wis., 2580.

APPENDIX M M.

REPORT OF CAPT. W. L. MARSHALL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Chicago Harbor, Ill., 2596; Calumet Harbor, Ill., 2602; Calumet River, Ill. and Ind., 2606; Illinois River, Ill., 2611; operating and care of La Grange Lock on Illinois River, Ill., 2630; Illinois and Mississippi Canal, 2633.
EXAMINATION AND SURVEY.—Illinois River, Ill., from La Salle to the Mississippi River, 2658.
HARBOR LINES.—Establishment of harbor lines in Chicago Harbor, Ill., 2661.

PART V.

APPENDIX N N.

REPORT OF MAJ. WILLIAM LUDLOW, CORPS OF ENGINEERS.

IMPROVEMENTS.—General remarks, 2667; Petoskey Harbor, Mich., 2670; Charlevoix Harbor and entrance to Pine Lake, Mich., 2672; Frankfort Harbor, Mich., 2674; harbor of refuge at Portage Lake, Mich., 2676; Manistee Harbor, Mich., 2678; Ludington Harbor, Mich., 2682; Pentwater Harbor, Mich., 2684; White River Harbor, Mich., 2687; Muskegon Harbor, Mich., 2689; Grand Haven Harbor, Mich., 2692; Holland [Black Lake] Harbor, Mich., 2696; Saugatuck Harbor, Mich., 2699; South Haven Harbor, Mich., 2700; St. Joseph Harbor, Mich., 2702; St. Joseph River, Mich., 2705; Michigan City Harbor, Ind., 2706.

APPENDIX O O.

REPORT OF COL. O. M. POE, CORPS OF ENGINEERS.

IMPROVEMENTS.—St. Marys River, Mich., 2712; operating and care of St. Marys Falls Canal, Mich., 2724; dry dock at St. Marys Falls Canal, Mich., 2758; Hay Lake Channel, St. Marys River, Mich., 2758; harbor at Cheboygan, Mich., 2764; harbor at Thunder Bay, Mich., 2765; Thunder Bay River, Mich., 2768; harbor at Au Sable, Mich., 2771; Saginaw River, Mich., 2772; harbor of refuge at Sand Beach, Lake Huron, Mich., 2776; Black River at Port Huron, Mich., 2780; mouth of Black River, Mich., 2782; St. Clair Flats Canal, Mich., 2784; operating and care of St. Clair Flats Canal, Mich., 2787; Clinton River, Mich., 2788; Grosse Pointe Channel, Mich., 2790; Rouge River, Mich., 2791; Detroit River, Mich., 2793; removing sunken vessels or craft obstructing or endangering navigation, 2801.
EXAMINATIONS.—Sebewaing River, Mich., 2804; the American channel of the Detroit River, Mich., 2808; ship channel 20 feet in depth in the shallows of the connecting waters of the lakes between Chicago, Duluth, and Buffalo, 2810; Corsica Shoal, Mich., at lower end of Lake Huron, 2820; Rouge River, Mich., 2822.

APPENDIX P P.

REPORT OF MAJ. L. COOPER OVERMAN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Monroe Harbor, Mich., 2825; Toledo Harbor, Ohio, 2828; Port Clinton Harbor, Ohio, 2835; Sandusky City Harbor, Ohio, 2837; Sandusky River, Ohio, 2840; Huron Harbor, Ohio, 2843; Vermillion Harbor, Ohio, 2847; Black River Harbor, Ohio; 2849; Cleveland Harbor, Ohio, 2853; Fairport Harbor, Ohio, 2859; Ashtabula Harbor, Ohio, 2863.

APPENDIX Q Q.

REPORT OF MAJ. AMOS STICKNEY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Erie Harbor, Pa., 2869; preservation and protection of Presque Isle Peninsula, Erie Harbor, Pa., 2877; Dunkirk Harbor, N. Y., 2878; Buffalo Harbor, N. Y., 2882; Tonawanda Harbor and Niagara River, N. Y., 2888; Wilson Harbor, N. Y., 2891; Olcott Harbor, N. Y., 2893; Oak Orchard Harbor, N. Y., 2896.

APPENDIX R R.

REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

IMPROVEMENTS.—Harbor at Charlotte, N. Y., 2899; harbor at Pultneyville, N. Y., 2903; harbor at Great Sodus Bay, N. Y., 2906; harbor at Little Sodus Bay, N. Y., 2909; harbor at Oswego, N. Y., 2912; harbor at Sacketts Harbor, N. Y., 2918.

APPENDIX S S.

REPORT OF MAJ. M. B. ADAMS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Shoal between Sister Islands and Cross-over Light, St. Lawrence River, N. Y., 2922; Ogdensburg Harbor, N. Y., 2923; Grass River, N. Y., 2926; breakwater at Rouse Point, Lake Champlain, N. Y., 2927; Great Chazy River, N. Y., 2929; breakwater at Gordon Landing, Lake Champlain, Vt., 2930; Plattsburg Harbor, N. Y., 2931; Burlington Harbor, Vt., 2932; Otter Creek, Vt., 2935; Ticonderoga River, N. Y., 2936; Narrows of Lake Champlain, N. Y. and Vt., 2937.
EXAMINATIONS.—Inner Bay, near mouth of Saranac River, at Plattsburg, N. Y., 2938; Boquet River, N. Y., from mouth on Lake Champlain to Willsboro, 2940.

APPENDIX T T.

REPORT OF COL. G. H. MENDELL, CORPS OF ENGINEERS.

IMPROVEMENTS.—Oakland Harbor, Cal., 2943; survey of San Francisco Harbor, San Pablo and Suisun bays, strait of Karquines, and mouths of San Joaquin and Sacramento rivers, Cal., 2947.
HARBOR LINES.—Modification of harbor lines on Port Costa front, south shore of Karquines Strait, San Francisco Harbor, Cal., 2948.

APPENDIX U U.

REPORT OF LIEUT. COL. W. H. H. BENYAURD, CORPS OF ENGINEERS.

IMPROVEMENTS.—Napa River, Cal., 2952; Redwood Harbor, Cal., 2953; Redwood Creek, Cal., 2953; San Luis Obispo Harbor, Cal., 2955; Wilmington Harbor, Cal., 2956; San Diego Harbor, Cal., 2960.
EXAMINATIONS.—San Rafael River, Cal., 2963; Alviso Harbor and Alviso Creek, Cal., 2964; Redwood Creek, Cal., 2966; harbor of refuge at Santa Cruz, Cal., 2968; San Simeon Bay, Cal., 2971; Redondo Beach Harbor, Cal., 2972; Colorado River, Ariz., above Yuma, to Eldorado Canyon, 2974.
HARBOR LINES.—Establishment of harbor lines at San Pedro, Wilmington Harbor, Cal., 2976.

APPENDIX V V.

REPORT OF MAJ. W. H. HEUER, CORPS OF ENGINEERS.

IMPROVEMENTS.—San Joaquin River, Cal., 2981; Mokelumne River, Cal., 2986; Sacramento and Feather rivers, Cal., 2987; investigation of mining-débris question in State of California, 2996; Petaluma Creek, Cal., 3119; Humboldt Harbor and Bay, Cal., 3120.
EXAMINATION AND SURVEY.—Mokelumne River, Cal., 3133.
HARBOR LINES.—Establishment of harbor lines in Humboldt Bay, Cal., 3138.

APPENDIX W W.

REPORT OF CAPT. THOMAS W. SYMONS, CORPS OF ENGINEERS.

IMPROVEMENTS.—Coquille River, Oregon, 3146; entrance to Coos Bay, Oregon, 3154; Umpqua River, Oregon, 3169; mouth of Siuslaw River, Oregon, 3173; entrance to Yaquina Bay, Oregon, 3182; Tillamook Bay and Bar, Oregon, 3200; entrance to harbor at Nehalem Bay, Oregon, 3205; Upper Columbia and Snake rivers, Oregon and Wash., 3210; Columbia River between head of Rock Island Rapids and foot of Priest Rapids, Wash., 3223; Chehalis River, Wash., 3236; Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie rivers, Wash., 3238.

EXAMINATIONS AND SURVEYS.—Alsea Bay and River, Oregon, 3246; Clark Fork of Columbia River from international boundary line to mouth of Big Blackfoot River, Mont., 3250; Puyallup River, Wash., 3255; D'Wamish and Black Rivers, Wash., 3257; ship channel between Port Townsend Bay, Puget Sound, and Oak Bay, Wash., 3260; North River, Wash., 3263; Shoalwater Bay and Willapah River, Wash., 3266; Nooksack, Skagit, and Snohomish rivers, Wash., 3271; Coquille River, Oregon, from Coquille City to Myrtle Point, 3275; Coos Bay, Oregon, 3283; Upper Snake River, Idaho, 3285; Nasel River, Wash., 3294; Grays Harbor and Bar and Chehalis River up to Montesano, Wash., 3297; Port Orford Harbor, Oregon, 3305.

APPENDIX X X.

REPORT OF MAJ. THOS. H. HANDBURY, CORPS OF ENGINEERS.

IMPROVEMENTS.—Mouth of Columbia River, Oregon and Wash., 3314; canal at the Cascades, Columbia River, Oregon, 3328; Columbia and Lower Willamette rivers below Portland, Oregon, 3362; Willamette River above Portland, Oregon, 3368; Cowlitz River, Wash., 3370; Youngs and Klaskuine rivers, Oregon, 3371; gauging waters of Columbia River, Oregon and Wash., 3372; removing sunken vessels or craft obstructing or endangering navigation, 3373.

EXAMINATIONS AND SURVEYS.—Willamette River, channel on west side of Swan Island, Oregon, 3373; Youngs Bay Channel, Oregon, 3376; Deep, Skamokawa, and Crooked rivers, Wash., 3378; Lower Columbia River, between Astoria and Woods Landing, Oregon, 3380: Yamhill River, Oregon, 3381; Lewis and Clarke River, Oregon, 3383; Grays River, Wash., 3385.

HARBOR LINES.—Establishment of harbor lines in Astoria Harbor, Oregon, 3387.

APPENDIX Y Y.

REPORT OF CAPT. W. A. KIRKLAND, UNITED STATES NAVY.

SUPERVISION of the harbor of New York, 3393.

PART VI.

APPENDIX Z Z.

REPORT OF THE MISSISSIPPI RIVER COMMISSION.

C. B. COMSTOCK, Colonel, Corps of Engineers, Bvt. Brig. Gen., U. S. A., President; CHARLES R. SUTER, Lieutenant-Colonel, Corps of Engineers, U. S. A.; O. H. ERNST, Major, Corps of Engineers, Colonel, U. S. A.; HENRY L. WHITING, Assistant U. S. Coast and Geodetic Survey; B. M. HARROD, ROBERT S. TAYLOR, and HENRY FLAD, *Commissioners*.

ANNUAL REPORT FOR FISCAL YEAR ENDING JUNE 30, 1891, 3397.

APPENDIX A.—Report of Lieut. Col. Charles R. Suter, Corps of Engineers, upon investigation of discharge measurements, Mississippi River, 3417.

APPENDIX B.—Paper by Lieut. Col. Charles R. Suter, Corps of Engineers, on effects of crevasses upon gauge readings below Red River during high water of 1890, 3444.

APPENDIX C.—Report of the secretary of the Commission, 3446; (1) paper by Capt. Charles F. Powell, Corps of Engineers, on depression of the flood line, 1890, below Red River, from crevasses, 3463; (2) paper by Capt. Charles F. Powell, Corps of Engineers, on effects of outlets on the bed of the river below them, 3465; (3) instructions for secondary triangulation, precise level, and topographical and hydrographical field work, 3474; (4) report of Mr. J. A. Ockerson, assistant engineer, on profile of Mississippi River, Cairo to Donaldsonville, 3486; (5) tabulated results of discharge measurements on Mississippi, Old, and Atchafalaya rivers, 1887–1889, 3487; (6) tabulated results of discharge measurements on Mississippi and Atchafalaya rivers and Bayou La Fourche, 1890, 3526; (7) high-water marks of 1890, Mississippi River, Cairo, Ill., to Carrollton, La., 3547; (8) high-water marks of 1891, Mississippi River, Cairo, Ill., to Carrollton, La., 3551; (9) high and low waters, referred to present or most recent gauges, of Mississippi River and principal tributaries except the Missouri, 3555; (10) report of Mr. J. A. Ockerson, assistant engineer, on changes in the bed of Mississippi River near the head of the Passes, 3575; commercial statistics, 3576.

APPENDIX D.—Report of Capt. S. W. Roessler, Corps of Engineers, on operations in the first and second districts, 3580; (1) report of Mr. Aug. J. Nolty, assistant engineer, on work at Plum Point Reach, 3595; (2) paper by Mr. Aug. J. Nolty, assistant engineer, on details of construction of bank protection at Plum Point Reach, 1890, 3601; (3) paper by Mr. Aug. J. Nolty, assistant engineer, on details of construction of pile dikes at Plum Point Reach, 1890, 3606; (4) report of Mr. W. M. Rees, assistant engineer, on proposed system of levees along St. Francis Front, 3610; (5) report of Mr. W. M. Rees, assistant engineer, on levee survey, White River Front, 3612; financial statements, commercial statistics, etc, 3619.

APPENDIX E.—Report of Capt. C. McD. Townsend, Corps of Engineers, on operations in the third district, 3627; (1) report of Mr. Wm. P. Richards, surveyor, on surveys and observations, third district, 3658; (2) report of Mr. John J. Hoopes, assistant engineer, on discharge observations at Arkansas City, 3660; (3) estimate of Mr. Henry B. Richardson, chief engineer, State of Louisiana, for levee construction in Louisiana from State line to Warrenton, 3662; (4) report of Capt. Wm. T. Rossell, Corps of Engineers, on connection between Arkansas River levees and Mississippi River levees, 3663.

APPENDIX F.—Report of Lieut. John Millis, Corps of Engineers, on operations in the fourth district, 3665; (1) report of Lieut. John Millis, Corps of Engineers, on survey of Mississippi River, near Natchez, Miss., and Vidalia, La., 3716.

APPENDIX A A A.

REPORT OF THE MISSOURI RIVER COMMISSION.

CHAS. R. SUTER, Lieutenant-Colonel, Corps of Engineers, U. S. A., President; A. MACKENZIE, Major, Corps of Engineers, U. S. A.; O. H. ERNST, Major, Corps of Engineers, Colonel, U. S. A.; GARLAND C. BROADHEAD and RICHARD S. BERLIN, *Commissioners.*

ANNUAL REPORT FOR FISCAL YEAR ENDING JUNE 30, 1891, 3723.

APPENDIX A.—Annual report of Secretary, Missouri River Commission, 1891, 3733; (1) report on the commerce on Missouri River during year 1891, 3737; (2) annual report of Mr. G. A. Marr, assistant engineer, 1891, 3745; (3) annual report of Mr. O. B. Wheeler, assistant engineer, 1891, 3756; (4) tables of results of secondary triangulation of Missouri River, 3760; (5) report of Mr. Chas. F. Potter, division engineer, on shore-line surveys, 3802; (6) report of Mr. S. Waters Fox, division engineer, on shore-line surveys, 3804; (7) report of Mr. Samuel H. Yonge, division engineer, on shore-line surveys, 3805; (8) annual report of Mr. D. W. Wellman, assistant engineer, 1891, 3807; (9) annual report of Mr. A. H. Blaisdell, assistant engineer, 1891, 3819; (10) annual report of Mr. James A. Seddon, assistant engineer, 1891, 3827.

APPENDIX B.—Annual report of Lieut. Hiram M. Chittenden, Corps of Engineers, 1891, 3831.

APPENDIX C and C 1.—Annual reports of Mr. Chas. F. Potter, division engineer, 1891, 3832.

APPENDIX D.—Annual report of Mr. S. Waters Fox, division engineer, 1891, 3835.

APPENDIX E.—Annual report of Mr. Samuel H. Yonge, division engineer, 1891, 3848.

APPENDIX B B B.

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

REPORT of The Board of Engineers on proposed bridge across Hudson River at New York City, 3853; report of Board of Engineers on bridge across Chicago River at Canal street, Chicago, Ill., 3861.

APPENDIX C C C.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

(1) REPORT of Lieut. Col. G. L. Gillespie, Corps of Engineers, 3865; (2) report of Col. Wm. P. Craighill, Corps of Engineers, 3866; (3) report of Capt. H. S. Taber, Corps of Engineers, 3867; (4) report of Col. O. M. Poe, Corps of Engineers, 3868; (5) report of Maj. Amos Stickney, Corps of Engineers, 3872; (6) report of Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, 3873.

APPENDIX D D D.

REPORT OF LIEUT. COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS.

WASHINGTON AQUEDUCT, 3875; water supply, District of Columbia, 3897; increasing the water supply of Washington, D. C., 3904; erection of fishways at Great Falls, 3905.

APPENDIX E E E.

REPORT OF COL. O. H. ERNST, UNITED STATES ARMY.

IMPROVEMENT and care of public buildings and grounds in the District of Columbia, Washington Monument, 3907.

APPENDIX F F F.

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

RESURVEY of Marquette Harbor, Michigan, 3927; issue of published charts of the northern and northwestern lakes, 3927.

APPENDIX G G G.

REPORT OF MAJ. WILLIAM A. JONES, CORPS OF ENGINEERS.

CONSTRUCTION and improvement of roads and bridges in the Yellowstone National Park, 3931.

APPENDIX H H H.

EXPLORATIONS AND SURVEYS IN DIVISIONS AND DEPARTMENTS.

REPORT of Capt. W. L. Marshall, Corps of Engineers, Engineer Officer, on operations in Division of the Missouri, 3943; report of Capt. Charles H. Clark, Ordnance Department, Acting Engineer Officer, on operations in Department of the Columbia, 3945; report of Lieut. Charles A. Worden, Seventh Infantry, Acting Engineer Officer, on operations in Department of the Platte, 3946; report of Lieut. James E. Runcie, First Artillery, Acting Engineer Officer, on operations in Division of the Pacific, 3947.

ANNUAL REPORT

OF THE

CHIEF OF ENGINEERS,

UNITED STATES ARMY.

1891.

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REPORT

OF

THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., September 23, 1891.

SIR: I have the honor to present for your information the following report upon the duties and operations of the Engineer Department for the fiscal year ending June 30, 1891:

OFFICERS OF THE CORPS OF ENGINEERS.

The number of officers holding commissions in the Corps of Engineers, U. S. Army, at the end of the fiscal year was 113.

Since the last annual report the corps has lost three of its officers, Capt. Frederick A. Hinman, by retirement, February 26, 1891, in conformity with section 1251, Revised Statutes; Capt. Willard Young and Lieut. Eugene J. Spencer, by resignation, February 22, 1891, and August 12, 1890, respectively.

On the 30th of June, 1891, the officers were distributed as follows:

Commanding the Corps of Engineers and the Engineer Department	1
Office of the Chief of Engineers	3
Board of Engineers, fortifications, river and harbor works, and Division Engineer	1
Board of Engineers, Board of Ordnance and Fortification, and Division Engineer	1
Fortifications, river and harbor works, and Division Engineers	2
Board of Engineers, Mississippi River Commission, Division Engineer, and Board of Visitors	1
Board of Engineers, fortifications, river and harbor works, and Board of Visitors	2
Washington Aqueduct	1
River and harbor works	37
Fortifications, and river and harbor works	23
Mississippi River Commission and Missouri River Commission	1
Fortifications, Post of Willets Point, U. S. Engineer School, and Batallion of Engineers	1
River and harbor works, and Missouri River Commission	1
Public buildings and grounds, Mississippi River Commission, and Missouri River Commission	1
Battalion of Engineers, and U. S. Engineer School	15
Mississippi River Commission	1
Fortifications	1
Missouri River Commission	1
Battalion of Engineers, and Electrical Board, D. C	1
Sick leave of absence	2
Detached, with Board of Commissioners of the District of Columbia, at Military Academy, with Light-House Establishment, and as military attachés	16
	113

The officers detached were on duty as follows:

Lieut. Col. Henry M. Robert, Engineer Commissioner of the District of Columbia	1
Lieut. Col. John M. Wilson, Superintendent Military Academy	1
Maj. David P. Heap, engineer third light-house district	1
Maj. William S. Stanton, engineer first and second light-house districts	1
Maj. James C. Post, military attaché to the United States legation at London	1
Capt. John C. Mallery, engineer fifth and sixth light-house districts	1
Capt. Frederick A. Mahan, engineer fourth light-house district, and, temporarily, engineer secretary of the Light-House Board	1
Capts. William T. Rossell and James L. Lusk, assistants to the Engineer Commissioner of the District of Columbia	2
Capt. George McC. Derby, and Lieuts. Eugene W. VanC. Lucas and Charles H. McKinstry, on duty with Company E, Battalion of Engineers, and at Military Academy	3
Capt. Theodore A. Bingham, military attaché to the United States legation at Berlin	1
Lieuts. Harry F. Hodges, Lansing H. Beach, and Joseph E. Kuhn, on duty at Military Academy	3
	16

In section 3 of the act of October 1, 1890, "An act to provide for the examination of certain officers of the Army and to regulate promotions therein," occurs this proviso:

That the examination of officers appointed in the Army from civil life, or of officers who were officers of volunteers only, or were officers of the militia of the several States called into the service of the United States, or were enlisted men in the regular or volunteer service, either in the Army, Navy, or Marine Corps, during the war of the rebellion, shall be conducted by boards composed entirely of officers who were appointed from civil life or of officers who were officers of volunteers only during said war, and such examination shall relate to fitness for practical service and not to technical and scientific knowledge; and in case of failure of any such officer on the reexamination hereinbefore provided for, he shall be placed upon the retired list of the Army.

All officers of the Corps of Engineers who are affected by this proviso were appointed cadets at the United States Military Academy, and graduated there, subsequently to their service during the war of the rebellion. They have all, since graduation, served more than 20 years on the various duties committed to the Corps of Engineers; all have attained the grade of captain and have passed examinations for promotion to the grades successively of first lieutenant and captain.

These officers should be able to pass a satisfactory examination on the technical and scientific knowledge required to discharge the duties of an officer of the Corps of Engineers.

It is recommended that officers of the Corps of Engineers be excepted from the provisions of this third section, above quoted, and that the examination of an officer of the Corps of Engineers as to professional efficiency shall be by the legal board upon which there shall be three officers of engineers, senior to him in rank, the former requirement of Revised Statutes section 1206.

FORTIFICATIONS

For 15 years prior to August 18, 1890, no appropriations had been made for the construction of works of seacoast defense. In this period great advances have been made in the construction of ordnance; and the increased power developed rendered necessary works of increased resistance to projectiles. In the naval ordnance of foreign powers are to be found guns of 100 and 110 tons, mounted in vessels belonging to Great Britain and Italy. The existence of this ordnance afloat necessitates a certain corresponding resistance of works of defense, a corre-

sponding thickness of cover. It is not probable that a further increase of cover will be required. Already the substitution of 67-ton guns for those of 110 tons is seriously discussed, and the tendency on the part of foreign powers is toward the adoption of the gun of lesser weight for its heaviest caliber afloat. The time, then, is propitious for the construction of modern fortifications. General projects for the defense of Portland, Me., Boston, New York, Washington, Hampton Roads, and San Francisco, have been prepared and have received the approval of the Chief of Engineers and the Secretary of War, and under the appropriations of August 18, 1890, and February 24, 1891, $1,221,000 and $750,000, respectively, works have been commenced in furnishing emplacements for high-power guns.

The act of August 18, 1890, requires that the amount appropriated thereby should be applied as follows: Boston, $235,000; New York, $726,000; San Francisco, $260,000. Of these amounts there remain soon to be allotted, on the receipt of detailed projects, amounts as follows: Boston, $63,960.73; San Francisco, $59,000.

Of the appropriation of February 24, 1891, the following allotments have been made: To the defenses of New York, $285,349.25; Hampton Roads, $158,848; Washington, $117,150; and San Francisco, $15,000. A balance of $173,652.75 remains, which will shortly be allotted to works at Boston and San Francisco, upon the receipt of detailed projects in course of preparation. Details of the works contemplated and in course of construction under the allotments from both appropriations are given below.

While the general projects prepared contemplate the use of turrets, shields, barbette batteries, and mortar batteries, the works now under construction are barbette batteries, including those in which guns are mounted on lifts, and mortar batteries. No works which contemplate the use of iron are now being built, but concrete covered with sand is used to shield the armament and gunners, and the disappearing principle of mounting guns has generally been had in view in designing batteries.

For the construction of gun and mortar batteries an estimate of $2,647,000 is submitted. This amount, with appropriations already made, will be required to supply emplacements for only such armament as will be fabricated by January 1, 1894. To prepare emplacements for the armament to be completed by January 1, 1893, an estimate of $1,735,000 was submitted; as $750,000 only was appropriated, the present estimate necessarily greatly exceeds the amount of the last appropriation.

The last Congress appropriated $1,000,000 for the procurement of land, or right pertaining thereto, needed as sites for fortifications and coast defenses. The act of August 18, 1890, authorized the acquisition of such sites by condemnation, purchase, or donation; $343,692.74 has been allotted and $250,000 so far expended for the purchase of 51½ acres in Boston Harbor, 36¼ acres in New York Harbor, and 200 acres at Sheridans Point, on the Potomac River near Fort Washington; and for the expenses preliminary to the condemnation of other sites. The Department of Justice has been requested to institute proceedings for the condemnation of 167 acres in New York Harbor, 54 acres at San Francisco, 91 acres at Sheridans Point, and 44½ acres at Hampton Roads; and for a site of 50 acres at Plumb Island, New York, an award has been made. In this case land valued by the United States at $50,000, and by the owner at $150,000, was valued by the jury at $90,000. Judging from this isolated case the existing balance of appropriations

not allotted will not suffice for the acquisition of the sites whose condemnation has been requested. Other sites also being necessary for carrying out existing projects of defense, an estimate of $500,000 is submitted for the acquisition of additional sites for gun and mortar batteries.

For the protection, preservation, and repair of fortifications, for which there may be no special appropriation available, $80,000 was appropriated August 18, 1890, and an equal amount February 24, 1891. As special appropriations are no longer made for individual works, these amounts must be applied to the ordinary expenses and the preservation and repair of all existing fortifications; no part of the general appropriations for the construction of gun and mortar batteries being thus applied. Accordingly allotments were made for current expenses and for the most urgent and necessary repairs of works; a balance of $7,257.46 being now held in reserve for such special repairs and contingencies as can not now be foreseen. For many years, previous appropriations for this purpose ranged from $100,000 to $175,000, and were found necessary; it is not prudent to reduce these below the amounts of each of the last two appropriations, and therefore an estimate of $80,000 for the protection, preservation, and repair of fortifications is submitted.

For the construction of needful casemates and cable galleries there was appropriated August 18, 1890, $100,000, and February 24, 1891, $50,000. At the date of my last annual report there were building or completed casemates, as follows: 2 at Boston, 5 at New York, and 2 at San Francisco. These nine are now completed, and as their average cost was found to be less than the amounts allotted for their construction, the balances of a previous appropriation were re-allotted to other works.

Projects have been prepared and approved for additional casemates, as follows: Portland, 1; Philadelphia, 1; Washington, 1; Hampton Roads, 1; Charleston, 1; San Francisco, 1; in all, six. Projects are being prepared for two for the defense of Narragansett Bay, and an additional casemate at Philadelphia. The construction of these three will probably consume the existing available balance of previous appropriations, which is $104,753.21. Seventeen casemates are thus provided for the places named, but the proposed defenses call for thirty. The construction of these important auxiliary defenses should continue, and for this purpose an estimate of $200,000 is submitted, which will probably suffice for six casemates.

Additional sea walls and embankments are required at Davids and Governors islands. At Davids Island, besides protecting the shore, 1½ acres of land will be reclaimed by a wall and embankment 1,100 feet long; at Governors Island a wall 325 feet long is required on the east side to replace wharf fronts and timber bulkheads now decaying and rapidly deteriorating.

The restoration of Fort Marion, St. Augustine, Fla., and the improvement of the grounds has been carried on under a special appropriation of $15,000; $6,000 is asked to complete this work. A detailed report is given below.

Boston Harbor, Massachusetts.—Officer in charge, Lieut. Col. S. M. Mansfield, Corps of Engineers, with Capt. S. S. Leach, Corps of Engineers, under his immediate orders.

The approved project for the defense of this harbor contemplates, for the present, an armament of twelve 12-inch guns on lifts, fifteen 10-inch

and five 8-inch guns on disappearing carriages, one hundred and twenty-eight 12-inch mortars, and submarine mines to be operated from four mining casemates. An emplacement for one 8-inch gun is under construction; the necessary demolition of old masonry and earthwork has been well advanced toward completion and considerable new concrete material collected and stored; detailed plans for two emplacements for 10-inch guns are near completion; a mortar battery for sixteen mortars was commenced late in June, 1891; two mining casemates have been completed.

New York Harbor, New York.—Officers of the Corps of Engineers in charge: Col. D. C. Houston, Lieut. Col. G. L. Gillespie, with Lieut. Harry Taylor under his immediate orders, and Lieut. Col. W. R. King.

The projects for the defenses of both the southern and eastern entrances to this harbor contemplate, for the present, an armament of nineteen 12-inch guns on lifts, seventeen 10-inch and nine 8 inch guns on disappearing carriages, one hundred and seventy-six 12-inch mortars, and submarine mines operated from five mining casemates. The five mining casemates are completed. Emplacements have been commenced for two 12-inch guns on lifts, six 8-inch guns, and thirty-two 12-inch mortars.

Colonel Houston reports as to the construction of three emplacements for 8-inch guns: 16,620 cubic yards of earth has been excavated and placed in embankment; the construction of a concrete-mixer has been begun, and material for concrete has been purchased.

Lieutenant-Colonel Gillespie reports: All the excavations for the foundations of the northern half of the two 12-inch gun battery and nearly all those for the southern half were finished, and about 3,500 cubic yards of concrete and rough stone had been put in place, mainly in the northern half. The foundation for the accumulator pit, 5 feet below low water, has been successfully laid, and the curb for the shot lift is nearly adjusted. This latter penetrates the sand to a depth of 22 feet below low water. It is expected that the masonry will be finished so as to enable the contractors for the ironwork to erect the mechanism of one lift early in the winter.

For the mortar battery 30,000 cubic yards of sand was excavated, completing the excavations for the gun pits, passageways, and magazines. Machinery has been set up and all other preparations made for the rapid and economical manufacture and deposit of concrete.

Lieutenant-Colonel King reports work on one of three emplacements for 8-inch guns as well under way. The excavation for the magazine and its approaches has been made, and concrete is being put in at the rate of about 75 cubic yards, soon to be increased to 100 or more cubic yards, per day.

This officer also reports that 400 cubic yards of rock and 1,600 cubic yards of earth have been removed on the site of a battery for sixteen mortars.

Washington, District of Columbia.—Officer in charge, Lieut. Col. Peter C. Hains, Corps of Engineers.

The approved project of defense contemplates emplacements for four 12-inch guns on lifts, six 10-inch and three 8-inch guns on disappearing carriages, eight 12-inch mortars, and submarine mines operated from two mining casemates. Detailed plans of emplacements for two 8-inch guns have been prepared and approved, and the emplacements are about to be commenced, and one mining casemate is under way.

Hampton Roads, Virginia.—Officer in charge, Lieut. Col. Peter C. Hains, Corps of Engineers, with Lieut. George A. Zinn, Corps of Engineers, under his immediate orders.

The approved project of defense contemplates, for the present, five 12-inch guns on lifts, ten 10-inch guns on disappearing carriages, thirty-two 12-inch mortars, and submarine mines operated from two mining casemates. Plant and materials have been collected for the construction of two emplacements for 8-inch guns, the concrete work of the mining casemate is completed, and the sand cover is being put in place.

San Francisco Harbor, California.—Officer in charge, Col. George H. Mendell, Corps of Engineers, with Lieuts. Henry C. Newcomer, and Charles L. Potter, Corps of Engineers, under his immediate orders, the former since September 4, 1889, the latter since June 17, 1891.

The approved project of defense contemplates, for the present, eighteen 12-inch guns on lifts, twenty-three 10-inch and thirteen 8-inch guns on disappearing carriages; fifteen 12-inch, five 10 inch, and six 8-inch guns on non-disappearing carriages; one hundred and forty-four 12-inch mortars, and submarine mines operated from seven mining casemates. Two mining casemates are completed. A third was commenced in May, and excavation work continued through June. About 3,000 cubic yards was excavated for two emplacements for 8-inch guns, and a concrete-mixer and a stone-crusher have been ordered. Drawings of detailed plans have been made for emplacements for one 8-inch and three 10-inch guns, and the amount of concrete and excavation required has been computed. The drawings of sections remain to be made.

PROTECTION OF SITE OF FORT NIAGARA, NEW YORK.

Officer in charge, Maj. M. B. Adams, Corps of Engineers, until November 10, 1890; afterwards, Capt. Dan C. Kingman, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

Protection of site.—Operations have been in progress for the protection of the site under allotments made from the appropriations for "Sea walls and Embankments."

The project provided for the repair of the sea wall along the lake front, the construction of dikes of fascines, iron pickets, and stone along the river and a portion of the lake front, and the filling in behind these dikes to a height of 6 feet above low water, leaving a flat slope down to the water, then a suitable roadway, then a steeper slope to the general level of the site, to protect the lower slope by a growth of willows, and the upper slope by sod.

Under this project repairs have been made to the wall at the northwest angle, which had been breached and thrown down by the waves, and some 1,711 feet of dike has been built.

July 1, 1890, balance unexpended	$8,126.40
Amount allotted October 11, 1890	10,000.00
	18,126.40
June 30, 1891, amount expended during fiscal year	6,437.45
July 1, 1891, balance unexpended	11,688.95
July 1, 1891, balance available	11,688.95
Amount (estimated) required for completion of existing project	26,105.30
Amount that can be profitably expended in fiscal year ending June 30, 1893	13,000.00

(See Appendix No. 1.)

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR.

Officer in charge, Col. D. C. Houston, Corps of Engineers.

Davids Island, 21 miles distant by water from the Battery, New York City, is one of the principal recruiting stations of the Army. On the east side of the island was a bay into which garbage and refuse matter frequently drifted, becoming a source of annoyance and possible disease to the troops stationed there; separated from the bay by a low sand beach was a fresh-water pond, formerly used as a water supply during drought, and still used as an ice pond.

To protect the pond from salt water, as well as for sanitary reasons, the construction of a sea wall in front of this beach was recommended in 1883 and 1884. In 1886 $47,000 was estimated as the cost of a masonry wall about 980 feet long, with embankment behind, the wall to be placed near low-water line and to rise to 12 feet above mean low-water level.

Under the appropriation of September 22, 1888, $47,000 was allotted for this sea wall and embankment. Recent stringent regulations prevent the deposit of garbage in this vicinity; therefore a riprap wall with dimension stone capping was substituted for the masonry wall originally designed, the cost being less and the wall equally effective. The sea wall was completed in April, 1890; work on the embankment, which was in progress July 1, 1890, was completed September 13.

In March, 1891, at request of the Quartermaster's Department, an examination was made of the shore above the coal wharf on the west side of the island, where the bank has been caving for several years; the damage was found to have been serious during the past winter, and a survey was made as a basis for estimates of cost of protection there and at other points. The field work of this survey is just completed, and the officer in charge reports that protection of the shore northeast of the coal wharf is necessary, and should be undertaken as soon as practicable; he estimates $30,000 as the cost of a sea wall about 1,100 feet long, and of embankment behind it to reclaim and preserve about 1½ acres area.

The final report upon the survey will include a consideration of other points where protection of the shore is less immediately necessary.

July 1, 1890, balance unexpended	$15,798.94
June 30, 1891, amount expended during fiscal year	4,201.08
July 1, 1891, balance unexpended	11,597.86
July 1, 1891, balance available	11,597.86
Amount (estimated) required for completion of project submitted June 30, 1891	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893.	55,000,00

(See Appendix 2 A.)

SEA WALLS AT GOVERNORS ISLAND, NEW YORK HARBOR.

Officer in charge, Col. D. C. Houston, Corps of Engineers.

The project adopted in 1865 provided for inclosing the entire island by a sea wall. Under an allotment made in 1865, and other subsequent allotments and appropriations, walls were built on the south, southeast, east, and northwest sides of the island, which, with the Castle Williams wall and the ordnance wall, inclosed the entire island, with the exception of about 325 feet at the coal wharf, for which no estimate has heretofore been submitted, and about 1,515 feet on the west side of

the island, for which $50,000 was appropriated by act of August 18, 1890. A contract for the construction of this wall and for embankment back of it was made November 26, 1890; work of building the wall was begun in May, 1891, and is now in progress. To June 30, 1891, 144.05 cubic yards of concrete foundation and 153.59 linear feet of masonry wall were laid. Work on the embankment has not been begun.

A masonry wall should be built at the coal wharf on the east side of the island about 325 feet long, estimated to cost $17,000.

July 1, 1890, balance unexpended		$8,757.10
Amount appropriated by act approved August 18, 1890		50,000.00
		58,757.10
June 30, 1891, amount expended during fiscal year		5,016.12
July 1, 1891, balance unexpended		53,740.98
July 1, 1891, outstanding liabilities	$2,608.44	
July 1, 1891, amount covered by uncompleted contracts	47,446.76	
		50,055.20
July 1, 1891, balance available		3,685.78
Amount (estimated) required for completion of project submitted June 30, 1891		17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		17,000.00

(See Appendix 2 B.)

BEACH PROTECTION, WATER SUPPLY, AND SEWERAGE SYSTEM AT FORT MONROE, VIRGINIA.

Officer in charge, Lieut. Col. Peter C. Hains, Corps of Engineers, with Lieut. George A. Zinn, Corps of Engineers, under his immediate orders.

Beach protection.—The erosion of the beach on the bay side and to the northeastward of Fort Monroe has progressed to such an extent that the narrow strip of beach connecting Fort Monroe with the main land is in danger of being cut through.

An allotment from the appropriation for preservation and repair of fortifications enabled the construction of jetties to be commenced, the work being continued with an appropriation of $27,000 made for this purpose by act of February 24, 1891.

A contract was made March 4, 1891, for the construction of about 1,600 feet of pile jetty, and the work is now in progress. From present indications the erosion will be checked and accretions may result.

(See Appendix 3 A.)

Water supply.—The supply of water is dependent upon rain water stored in cisterns, and water of inferior quality brought across Mill Creek by a system of iron pipes. It is important that an adequate supply be had within the limits of the fortification. An appropriation of $10,000 for obtaining such a supply was recommended in my last annual report; $6,000 was appropriated by act of February 24, 1891. This amount not being sufficient to sink a well to a depth already demonstrated at this place to be insufficient, it has not been expended; and it is recommended that the additional $4,000, thought necessary, be appropriated.

(See Appendix 3 B.)

Sewerage system.—The act of March 2, 1889, appropriated $27,000 for a *complete* system of sewerage, inside and outside of the fort. Bids received for this work demonstrated the insufficiency of the appropriation

therefor. In February, 1891, the owners of private property on the reservation, as directed by the Secretary of War, submitted plans for a sewerage system for their buildings; with this system it is proposed to connect a system of sewerage for Government buildings for which the appropriation will suffice. These plans were returned for slight modification March 6, 1891, and have not been again submitted.

(See Appendix 3 C.)

REPAIR AND PRESERVATION OF FORT MARION, FLORIDA.

Officer in charge, Capt. W. M. Black, Corps of Engineers, with Lieut. David DuB. Gaillard, Corps of Engineers, under his immediate orders; Division Engineer, Col. William P. Craighill, Corps of Engineers.

By act of August 18, 1890, $15,000 was appropriated for the repair and preservation of this work, and for the construction of sea wall to preserve the site. Work was begun October 20, 1890, and continued to the close of the fiscal year; 342.5 feet of sea wall was built, the terreplein was paved and drained, communications were restored and renewed, window frames and sashes were replaced by iron gratings, door and window facings repaired, the ditch cleaned out and graded, glacis planes were restored, and all low places on the reservation filled and graded, fences were built, concrete paths laid, and many trees and plants put out. Additional and final work of restoration and improvement of fort and grounds remains, for which an estimate of $6,500 is submitted.

Amount appropriated by act approved August 18, 1890	$15,000.00
June 30, 1891, amount expended during fiscal year	13,782.00
July 1, 1891, balance unexpended	1,218.00
July 1, 1891, outstanding liabilities	575.84
July 1, 1891, balance available	642.16
Amount (estimated) required for completion of existing project	6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,500.00

(See Appendix No. 4.)

ESTIMATES OF APPROPRIATIONS REQUIRED FOR 1892-'93.

For construction of gun and mortar batteries	$2,647,000
For purchase of land for fortifications	500,000
For protection, preservation, and repair of fortifications	80,000
For preparation of plans for fortifications	5,000
For repair and preservation of Fort Marion, Florida, and for construction of sea wall to preserve the site	6,500
For artesian well at Fort Monroe, Virginia	4,000
For sea wall at Governors Island, New York Harbor	17,000
For sea wall at Davids Island, New York Harbor	30,000
For needful casemates, cable galleries, etc., from which to operate submarine mines	200,000
	3,489,500

THE BOARD OF ENGINEERS.

The Board, as at present constituted, consists of the following officers of the Corps of Engineers: Col. Henry L. Abbot, Col. C. B. Comstock, Col. D. C. Houston, Lieut. Col. G. L. Gillespie.

Col. G. H. Mendell, Corps of Engineers, is also a member of the Board when it is acting upon matters pertaining to the defensive works on the Pacific coast.

The Board has considered the various subjects referred to it during

the past year by the Chief of Engineers, and the following is a brief summary of the reports rendered thereon:

1890, July 7. On House Representatives 10,905, Fifty-first Congress, first session, a bill to authorize the construction of a bridge across the Hudson River between New York City and New Jersey.

July 23. On the necessary defenses of our entire Atlantic and Gulf coasts.

August 28. On expenses for the office of the Board for the year ending June 30, 1891.

August 28. On suggestions of Capt. J. G. D. Knight, Corps of Engineers, concerning the gun-lift designed by Colonel Abbot.

August 28. On the necessary defenses of the Pacific coast line, excepting Alaska.

September 8. On project for a gun-lift battery at Sandy Hook.

September 20. On land to be acquired for defensive purposes on Coney Island.

September 22. On the expenditure of funds appropriated by the act of August 18, 1890, for torpedo purposes.

October 6. On locations for mortar batteries for the defense of the eastern entrance to New York Harbor.

October 13. Relative to project of Lieut. Col. J. A. Smith, Corps of Engineers, of October 7, 1890, for a mining casemate and search-light room at Portland, Me.

October 14. On changes recommended by Lieut. Col. W. R. King, Corps of Engineers, in torpedo matériel.

November 24. On device of Boyd W. Desart for a portable pontoon bridge.

November 24. On project of Lieut. Col. P. C. Hains, Corps of Engineers, of November 13, 1890, for mining casemate and cable gallery at Fort Monroe, Va.

November 24. On project of Lieut. Col. J. A. Smith, Corps of Engineers, of October 18, 1890, for expenditure of $65,000 for improving Saco River, Maine.

December 1. Project for the expenditure of a balance of $60,000, act of March 2, 1889, "for needful casemates and cable galleries."

December 1. Views as to the rapid-firing guns which will be necessary for the seacoast defense of the United States.

December 17. General report on the defense of the port of San Francisco. The estimates for the works projected for the defense of this harbor were transmitted to the Chief of Engineers on April 25, 1891, and the final drawings on June 2, 1891.

December 22. On changes recommended by Lieut. Col. W. R. King, Corps of Engineers, in torpedo matériel.

December 22. Relative to bridge across Newark Bay to be constructed by the Jersey City, Newark and Western Railway Company.

December 22. On changes proposed by Lieut. Col. G. L. Gillespie, Corps of Engineers, in gun-lift battery at Sandy Hook.

December 31. On report of Lieut. Col. G. L. Gillespie, Corps of Engineers, relative to purchase of land at Fort Hamilton for defensive purposes.

1891. January 24. On torpedo invented by Lieutenant Borresen, Royal Norwegian Navy.

January 24. On plan of Messrs. Churchill and Mullen, for operating torpedoes from the shore.

January 27. On Senate 5,027, Fifty-first Congress, second session, "A bill in relation to the Departments of the Army of the United States."

March 2. On emplacements for guns provided for in the fortification act of February 24, 1891.

March 2. On communication of Lieut. Col. W. R. King, Corps of Engineers, recommending Harts Island as a site for fortification, instead of Cryders Point.

March 6. On expenses for the office of the Board for the year ending June 30, 1892.

March 11. On project of First Lieut. O. M. Carter, Corps of Engineers, of October 8, 1890, for expenditure of funds appropriated by act of September 19, 1890, for improving Cumberland Sound.

March 16. On project of Lieut. Col. J. A. Smith, Corps of Engineers, of January 5, 1891, for casemate and cable gallery at Portland Head, Me.

March 17. On modification proposed by Lieut. Col. S. M. Mansfield, Corps of Engineers, November 12, 1890, for emplacement for high-power gun at Fort Warren, Mass.

March 19. Project for expenditure of funds appropriated by act of February 24, 1891, for submarine mining defenses.

March 21. On bridge across Newark Bay to be constructed by the Jersey City, Newark and Western Railway Company.

April 4. On project of Lieut. Col. W. R. King, Corps of Engineers, of January —, 1891, for mortar battery on Davids Island.

April 7. On project of Lieut. Col. S. M. Mansfield, Corps of Engineers, of March 31, 1891, for mortar batteries on Grovers Cliff, Mass.

April 8. On revised project of Lieut. Col. J. A. Smith, Corps of Engineers, of April 2, 1891, for casemate and cable gallery at Portland Head, Me.

April 22. On project of Capt. F. V. Abbot, Corps of Engineers, of February 11, 1891, for casemate and cable gallery at Fort Sumter, S. C.

April 23. On bridge to be constructed by the North River Bridge Company across the Hudson River at New York under the act of July 11, 1890.

May 4. On projects of Lieut. Col. W. R. King, Corps of Engineers, of February 28 and March 30, 1891, for gun emplacement at Willets Point, N. Y.

May 16. On project of Lieut. Col. J. A. Smith, Corps of Engineers, of April 25, 1891, for improving Penobscot River, Maine.

May 16. On letter of the Chief of Ordnance of May 5, 1891, relative to emplacement for 12-inch B. L. rifle.

June 5. On project of Maj. C. W. Raymond, Corps of Engineers, of May 19, 1891, for casemate and cable gallery on Pea Patch Island, Delaware River.

June 6. On project of Lieut. Col. P. C. Hains, Corps of Engineers, of May 27, 1891, for emplacements for high-power guns at Fort Monroe, Va.

June 12. On construction of an additional casemate and cable gallery with balance of funds appropriated by act of February 24, 1891.

June 22. Project for the defense of Portland Harbor, Maine.

June 26. On application of Hudson Tunnel Railway Company to deposit a layer of clay on the bottom of the Hudson River on the line of its tunnel near the left bank.

In the performance of the duties of the Board, the following personal examinations were made:

To carry out the instructions of the Chief of Engineers contained in an indorsement dated February 4, 1890, the Board on August 28 and

29, and September 26, 1890, conducted experiments with circuit closers at Willets Point, New York, to determine the working of the system of torpedo obstruction.

Under instructions of the Chief of Engineers, dated December 18, 1890, the Board visited St. Johns River, Florida, and Cumberland Sound, on February 2, 1891, and Savannah, Ga., on February 5, 1891, in connection with its report on the project of Lieut. O. M. Carter, Corps of Engineers, of October 8, 1890, for expenditure of funds for improving Cumberland Sound.

Under instructions of the Chief of Engineers, dated April 6, 1891, the Board, on May 26, 1891, inspected the sites for fortifications in the harbor of Portland, Me.

In addition to their duties with The Board of Engineers, the individual members of the Board have been otherwise engaged, as follows:

1. Col. Henry L. Abbot, the president of the Board, has continued in charge of certain experiments with torpedoes; as a member of the Board of Ordnance and Fortification; as president of the board to fix the harbor lines for the harbor of New York and its adjacent waters; as president of the board to fix the harbor lines for the port of Boston, and as division engineer of the Northeast Division. He has also served as president of boards for examination of officers of the Corps of Engineers with a view to promotion.

2. Col. C. B. Comstock has served as division engineer of the Southwest Division; as member of the board of visitors to the United States Engineer School; as president of the Mississippi River Commission; as member of the board to fix the harbor lines of New York Harbor and its adjacent waters; as member of the board to fix the harbor lines of Philadelphia; as member of commission of engineer officers to report on the value of the channel constructed by the Buffalo Bayou Ship Channel Company; as member of boards for examination of officers of the Corps of Engineers with a view to their promotion; as member of board to select a site for a naval dry-dock on the Gulf of Mexico; and as member of board to report on a project for improving harbor at Sabine Pass, Texas.

3. Col. D. C. Houston has been the disbursing officer of The Board of Engineers. He has conducted the various works of river and harbor improvement and of fortifications under his charge, and has served as a member of the board of visitors to the United States Engineer School; as a member of the board to fix the harbor lines for the harbor of New York and its adjacent waters; as a member of boards to establish harbor lines in the harbors of Stamford and Bridgeport, Conn.; as member of commission to consider and report on the improvement of Wilmington Harbor, Del.; and as member of boards for examination of officers of the Corps of Engineers with a view to their promotion.

4. Lieut. Col. G. L. Gillespie, in addition to conducting the various works of river and harbor improvement and of fortification with which he was charged during the year, has served as a member of the board of visitors to the United States Engineer School; of the boards on harbor lines of New York Harbor and adjacent waters, of Stamford and Bridgeport Harbors, Conn., and of the port of Boston, Mass.; of boards on obstructions to navigation in the Hudson River, and on deep-water harbor on the Pacific coast between Points Duma and Capistrano; and as a member of board for examination of an officer of the Corps of Engineers with a view to his promotion.

POST OF WILLETS POINT, NEW YORK—UNITED STATES ENGINEER SCHOOL—BATTALION OF ENGINEERS--ENGINEER DEPOT.

Officer in command, Lieut. Col. W. R. King, Corps of Engineers.

POST OF WILLETS POINT, NEW YORK.

At the close of the fiscal year the garrison consisted of 27 commissioned officers and 333 enlisted men, including officers and non-commissioned officers of the general staff, student officers, and enlisted men of the Hospital Corps. This is a net loss of 51 men in enlisted strength over last year's report.

Some repairs and improvements have been made during the year to the roads and buildings.

The fire-proof building for engineer models is completed and partly occupied, and the coal shed, built by the Quartermaster's Department, has been in use during the year.

Most of this work was done by enlisted men detailed for the purpose.

Plans and estimates for lighting the public buildings and grounds by electricity were made last year; if these are not approved, the erection of a small plant for lighting the post by gas is recommended.

An allotment has been made for the construction of a new guard house and for a building to contain fire engines, etc.; these will be built during the year.

The necessity for new barracks, mess building and quartermaster and commissary storehouse has been so often reported that no further statement of the case seems necessary.

It is urged that the needs of this post and its garrison may be considered in the allotment of appropriation for barracks and quarters.

UNITED STATES ENGINEER SCHOOL.

During the year 3 engineer officers, 1 artillery officer, and 7 infantry officers completed the course, and 2 cavalry, 1 artillery, and 5 infantry officers who have completed the laboratory duty are still engaged in the practice work of planting and operating torpedoes, which it is expected will be completed October 1, 1891.

One infantry officer was, upon his own application, relieved from duty at the U. S. Engineer School on June 15, 1891, as per special orders No. 124, Headquarters Army, A. G. O., Washington, June 7, 1891.

It is believed that officers of fair intelligence and industrious habits, although lacking the benefit of a scientific education, can acquire a sufficient knowledge of electricity and high explosives to be useful not only in the torpedo service, but also in its simpler applications to military and civil engineering.

BATTALION OF THE CORPS OF ENGINEERS.

The legal strength of the Battalion of Engineers is five companies of 150 men each, with a sergeant-major and quartermaster-sergeant, and is officered by details from the commissioned officers of the corps.

The present strength is 20 officers and 417 enlisted men. The authorized strength of Companies A, B, and C, which are stationed at Willets Point, is 133 men each, and of Company E, stationed at West Point, 100 men.

The total losses from all causes during the year have been 160 and the total gains 130, making a net loss of 30 men.

The battalion has been employed during the year at engineer, ponton, and torpedo drill, infantry drill, rifle practice, and photography; and Company E, at West Point, has assisted in the instruction of cadets in military engineering and ponton drill.

ENGINEER DEPOT.

Plans and estimates for a new fireproof building, to replace the engineer depot storehouse destroyed by fire on May 10, 1890, have been completed, and as an appropriation was made at the last session of Congress of $16,000 for this purpose, work was commenced on July 1, 1891.

Plans and specifications for a small steam tug for planting torpedoes were completed with the aid of a naval architect, but owing to other more important matters work has not been begun as yet.

The steam tug *Star*, which was sunk during a severe storm in December last, was thoroughly repaired and will soon be available for service.

A quantity of ponton and bridge materials and equipage was procured during the year for the purpose of drill and instructions, and some of the old ponton boats which were used in the late war were repaired and fitted up for further use.

A new building to contain engine, boiler, and dynamos for the trials of the new Sims-Edison electric fish torpedo, now under contract, was begun and will be completed during the month of July, 1891.

A large quantity of submarine mining materials was procured and was shipped for storage to such points as have been designated; also a large quantity of tool boxes, tools, electrical supplies, and other classes of torpedo materials was procured and stored at this post.

Quite a number of engineer instruments was added to the depot supply by purchase, all of which are of approved patterns. Nearly all of the repairs to instruments was done at the depot. A large number of instruments and tools was transfered to officers on public works.

Torpedo experiments, tests of explosives, tests of cut-off boxes, tests with various building materials, tests of circuit closers, and methods of loading torpedoes were made during the year. Detailed reports of some of these tests have been made, and others will be reported on hereafter.

The U. S. S. *Quinnebaug* was procured and experiments were made with her by towing her over the mines for the purpose of testing the torpedo mechanism under something like service conditions. These experiments were made under direction of The Board of Engineers, to whom reports have been submitted.

STATEMENT OF FUNDS.

Congress has at various times appropriated as follows:

For engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1891	$12,529.63
Expended and pledged	12,529.63
For torpedoes for harbor defense, act of Sept. 22, 1888, no limit.	
July 1, 1890, balance unexpended	50,140.33
Expended to June 30, 1891	32,823.58
July 1, 1891, balance available	17,316.75

For torpedoes for harbor defense, act of Mar. 2, 1889; no limit.	
July 1, 1890, balance available	$296,945.25
Expended to June 30, 1891	189,608.32
July 1, 1891, balance available	107,336.93
For torpedoes for harbor defense, act of Aug. 18, 1890, no limit.	
Assigned during fiscal year	130,000.00
Expended to June 30, 1891	76,242.16
July 1, 1891, balance available	53,757.84
For torpedoes for harbor defense, act of Feb. 24, 1891, no limit.	
Assigned during fiscal year	21,695.00
Expended to June 30, 1891	4,952.92
July 1, 1891, balance available	16,742.08
For engineer depot at Willets Point, N. Y., for the fiscal year ending June 30, 1892	27,000.00

There will be required for the fiscal year ending June 30, 1893:

For incidental expenses of depot	$5,000.00
For purchase of materials for instruction of battalion	3,500.00
For purchase and repair of instruments	3,000.00
For purchase and binding of professional works for library	500.00
For purchase of ponton material	5,000.00
Total	17,000.00

(See Appendix No. 5.)

RIVER AND HARBOR IMPROVEMENTS.

The funds with which the works for the improvement of rivers and harbors were prosecuted during the last fiscal year were derived from the appropriations by the river and harbor act approved September 19, 1890, appropriations in the sundry civil act approved March 3, 1891, for certain works on account of which contracts were to be made for completion as provided in the act of September 19, 1890, and such balances of former appropriations as were available.

A brief statement, derived from the reports of the officers in charge of the several works hereinafter given, sets forth the condition of each improvement, the extent of work performed during the last fiscal year, the amount expended, and estimate of amount required for its completion.

Reports are appended of the work accomplished in the removal of wrecks obstructing or endangering navigation, as provided for in section 4 of the river and harbor act approved June 14, 1880, and enlarged by provision in the river and harbor act of August 2, 1882.

Part of the examinations and surveys provided for by the river and harbor act approved September 19, 1890, have been made, and the results thereof reported to Congress from time to time during the last session; these reports and the reports upon such examinations and surveys as have been made since the adjournment are appended to this report, and such as are not yet completed will be submitted for transmission to Congress as soon as received.

In the river and harbor act approved September 19, 1890, provision is made—

For the purchase of the two canals known as the Portage Lake and River Improvement Company Canal, from Keweenaw Bay to Portage Lake, and the Lake Superior Ship-Canal Railway and Iron Company Canal, from Portage Lake to Lake Superior,

being the water communication across Keweenaw Point, Lake Superior, from Keweenaw Bay to Lake Superior, in the State of Michigan, by way of the Portage River and Lake and the artificial cut made by said companies to render them available to commerce and navigation, together with the works of improvement on Portage Lake; the harbor works upon Lake Superior and Keweenaw Bay, with all lands and franchises connected therewith, free from all incumbrances, three hundred and fifty thousand dollars: *Provided*, That for the purpose of preserving and continuing the use and navigation of said canals, the sum of ten thousand dollars for each of the present and the next fiscal year be appropriated, out of any money in the Treasury not otherwise appropriated, or so much thereof as may be necessary, to pay the actual expenses of operating and keeping said canals in repair; and that an itemized statement of said expenses shall accompany the annual report of the Chief of Engineers: *And provided further*, That no money appropriated for this purpose shall be available until a valid title to all of said premises shall be vested in the United States, nor until the State of Michigan shall have ceded to the United States exclusive jurisdiction over the same, during the time the United States shall be or remain the owner thereof, for all purposes except the administration of the criminal laws of said State and the service of civil process on the lands and right of way so conveyed. The balance of the appropriation, to wit, five thousand one hundred and twenty-eight dollars and seventy cents, for examination of Portage Lake and Lake Superior Ship Canals, contained in the river and harbor act of August fifth, eighteen hundred and eighty-six, is hereby made available for each and every purpose connected with the establishment of new harbor lines in Portage Lake under the provisions of the act of June twentieth, eighteen hundred and ninety, authorizing and directing said establishment.

A valid title to all of said premises having been vested in the United States, and the State of Michigan having ceded the required jurisdiction over the same, the purchase money was paid to the said companies, and the United States assumed control of the canals August 3, 1891.

Under the authority given to the Secretary of War in section 12 of the river and harbor act approved September 19, 1890, harbor lines have been established at the following localities:

Lubec, Me.; Kennebec River at Bath, Me.; Boston, Mass.; New York Harbor and adjacent waters; Philadelphia, Pa.; New Castle, Del.; St. Augustine, Fla.; Duluth, Minn., Bay of St. Louis, Superior Bay and adjacent waters, Minnesota and Wisconsin; Portage Lake, Michigan; Chicago, Ill.; San Francisco Harbor and adjacent waters, California; San Pedro, Wilmington Harbor, California; Humboldt Bay, California; Astoria, Oregon.

Examinations were made, whenever required by the committees of Congress, of proposed bills authorizing the construction of bridges upon which the views of the War Department were desired. Of the bills so examined since my last report, to the close of the fiscal year, June 30, 1890, 25 originated in the Senate and 38 in the House of Representatives.

During the fiscal year examinations were made of such plans and locations as were submitted by parties interested, of bridges proposed to be built over navigable waters subject to the approval of the Secretary of War, as authorized by acts of Congress. A brief statement is given of the action had in such cases.

Under sections 4 and 5 of the river and harbor act approved September 19, 1890, persons, corporations, or associations owning or controlling bridges over navigable water-ways of the United States, which are unreasonable obstructions to the free navigation of such waters, after being given a reasonable opportunity to be heard, have been notified to so alter the bridges as to render navigation through or under them reasonably free, easy, and unobstructed. In each case the changes required to be made were specified in the notice, and a reasonable time was prescribed in which to make them. A detailed statement of the cases is given further on in this report.

Reports made in compliance with the requirements of section 2 of the river and harbor act of July 5, 1884, and section 4 of that of August 5, 1886, of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation, are used, occupied, or injured by a corporation or an individual, will be found in Appendix C C C.

The engineering works in the charge of this office are arranged in five divisions, and officers of the corps assigned as division engineers, to overlook the work, as follows:

West of the Rocky Mountains: Pacific Division, Col. George H. Mendell. East of the Rocky Mountains: Northeast Division, Col. Henry L. Abbot; Southeast Division, Col. Wm. P. Craighill; Southwest Division, Col. Cyrus B. Comstock; Northwest Division, Col. Orlando M. Poe.

South Pass of the Mississippi River.—During the fiscal year ending June 30, 1891, the legal channel was maintained through the Pass itself except for 3 days in April, when at one point the depth was 25 feet, and for 12 days the jetty channel had a central depth of from 27.5 feet to 29.4 feet.

ATLANTIC COAST AND GULF OF MEXICO.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

Officer in charge, Lieut. Col. Jared A. Smith, Corps of Engineers.

1. *St. Croix River, Maine.*—In compliance with requirements of the river and harbor act of August 11, 1888, an examination and survey of the St. Croix River was made in 1888 and 1889, and a report with plan of improvement and estimate of cost was submitted by the engineer officer in charge. (See Report of Chief of Engineers, 1889, page 463.)

By act of September 19, 1890, Congress appropriated $35,000 for the improvement "upon the condition that the Government of the Dominion of Canada shall expend a like sum in the improvement of the said river."

As it is not yet known what action the Dominion Government is disposed to take in this matter, no steps have been taken towards the expenditure of the appropriation.

Amount appropriated by act approved September 19, 1890	$35,000.00
July 1, 1891, balance unexpended	35,000.00
Amount (estimated) required for completion of existing project	245,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 1.)

2. *Lubec Channel, Maine.*—This channel lies between the eastern extremity of Maine and Campo Bello Island, belonging to the Dominion of Canada.

Originally the channel was but 5 feet in depth at mean low water, and but 2 feet at low water of spring tides.

The project adopted in 1879, and subsequently modified, is for a channel 275 feet wide, 300 feet wide in the bends, and 12 feet deep at mean low water.

Amount expended to June 30, 1890, $157,213.03.
Expended in last fiscal year, $11,716.39.
As a result, the channel has been so nearly completed as planned that no further estimate is submitted.
While the channel thus made is of great service, yet it is not straight and has not its full width near the upper end, where width is much needed.
Under provisions of the river and harbor act of September 19, 1890, a report, setting forth the desirability for widening and straightening the channel, was submitted to Congress in January, 1891, and printed as House Ex. Doc. No. 158, Fifty-first Congress, second session.*

July 1, 1890, balance unexpended	$18,894.07
June 30, 1891, amount expended during fiscal year	18,823.49
July 1, 1891, balance unexpended	70.58

(See Appendix A 2.)

3. *Moose-a-bec Bar, Maine.*—The project for this improvement was adopted in 1881, and modified in 1888, the object being to give a direct channel 300 feet wide and a depth of 14 feet at mean low water over the bar, and to remove ledges near and in the channel to a depth of 16 feet.
Amount expended to June 30, 1890, $53,417.68.
The channel over the bar had been dredged to a width of 300 feet and a depth of 14 feet at mean low water.
At certain stages of the tide strong currents set obliquely across the channel. To prevent these, a small breakwater is to be built from Pile of Ballast Ledge to Nova's Rock, and a beacon is to be built on the ledge at edge of channel.
Work upon the breakwater and beacon was commenced in June, 1891, under a contract. It will probably be completed before the close of the summer season.
Expenditures in the last fiscal year, $2,293.99.

July 1, 1890, balance unexpended		$1,582.32
Amount appropriated by act approved September 19, 1890		15,000.00
		16,582.32
June 30, 1891, amount expended during fiscal year		470.61
July 1, 1891, balance unexpended		16,111.71
July 1, 1891, outstanding liabilities	$1,823.38	
July 1, 1891, amount covered by uncompleted contracts	3,497.56	
		5,320.94
July 1, 1891, balance available		10,790.77

Amount (estimated) required for completion of existing project	80,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 3.)

4. *Pleasant River, Maine.*—In compliance with requirement of the river and harbor act of August 11, 1888, an examination of this river was made by the engineer officer in charge in November, 1888, and a survey was made in August, 1889.
The project adopted for the improvement is to mark the channel rocks by one stone beacon and one iron spindle, and to remove bowlders from the channel above Addison Point, at a total estimated cost of $3,500.

* See Appendix A 28.

Work was commenced in June, 1891, and the improvement will probably be completed in August.

Amount appropriated by act approved September 19, 1890	$3,500.00
July 1, 1891, balance unexpended	3,500.00
July 1, 1891, outstanding liabilities	270.60
July 1, 1891, balance available	3,229.40

(See Appendix A 4.)

5. *Narraguagus River, Maine.*—The obstruction to navigation consisted in a bar from the anchorage near the mouth of the river to deep water, the shoalest part having only 4 feet depth at extreme low water and 5½ feet at mean low water.

The project for improvement consists in dredging the channel to a depth of 11 feet as far as the lower landing and thence 9 feet deep to the anchorage.

The amount expended to June 30, 1890, was $20,000.

As a result the lower part of the channel had been dredged to grade, 55 feet in width and 2,800 feet long, thence 100 feet wide, a distance of 1,600 feet, and thence a width of 300 feet, forming a turning basin of about 600 feet length.

A contract was made in January, 1891, for continuing the dredging under the appropriation of September 19, 1890.

Work was commenced May 16, and will be completed in July. The improvement thus far is of considerable benefit to sailing vessels, but is especially valuable to steamers which touch at the lower wharves.

Expenditures in last fiscal year, $5,956.20.

Amount appropriated by act approved September 19, 1890		$7,500.00
June 30, 1891, amount expended during fiscal year		2,341.57
July 1, 1891, balance unexpended		5,158.43
July 1, 1891, outstanding liabilities	$3,614.63	
July 1, 1891, amount covered by uncompleted contracts	1,502.17	
		5,116.80
July 1, 1891, balance available		41.63
Amount (estimated) required for completion of existing project		22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		22,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix A 5.)

6. *Breakwater from Mount Desert to Porcupine Island, Maine.*—The anchorage and landing at Bar Harbor is entirely exposed to storms and seas from southerly directions.

The object of the improvement is to protect the harbor from southerly storms.

The act of August 11, 1888, appropriated $50,000 for commencing the work. A contract was subsequently made with the lowest bidder, but the failure of the contractor, as stated in last annual report, prevented any considerable progress.

The contract expired by limitation of time on the 30th of June, 1890.

Expenditures previous to June 30, 1890, were $13,711.78.

Expended in last fiscal year, $9,081.27.

In August, 1890, proposals were invited for delivery of stone in the breakwater to complete the work which had been abandoned by the former contractor, and a new contract was made with the lowest bidder.

After the approval of the contract it was too late to commence work before spring.

The delivery of stone was commenced April 25.

The act of September 19, 1890, appropriated $50,000 for continuing the work.

It has been deemed advisable not to invite proposals for delivery of stone under this appropriation until the progress of contractors under former appropriation could be observed.

Specifications have been prepared and a contract will be made at an early day for the last appropriation.

The original location and estimate of cost of the breakwater were based upon soundings upon Coast Survey chart. These have been found inaccurate; it has therefore been necessary to modify the location and estimate.

July 1, 1890, balance unexpended		$36,288.22
Amount appropriated by act approved September 19, 1890		50,000.00
		86,288.22
June 30, 1891, amount expended during fiscal year		5,432.75
July 1, 1891, balance unexpended		80,855.47
July 1, 1891, outstanding liabilities	$3,648.52	
July 1, 1891, amount covered by uncompleted contracts	24,625.63	
		28,274.15
July 1, 1891, balance available		52,581.32

Amount (estimated) required for completion of existing project	706,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 6.)

7. *Bagaduce River, Maine.*—The river and harbor act of August 5, 1886, required an examination or survey of the Bagaduce River, Maine.

A report, with estimate of cost of works considered necessary, was submitted by the engineer officer in charge, February 2, 1888. (See Report of Chief of Engineers for 1888, page 401.)

The project adopted for the improvement consists of deepening the channel to give a width of 100 feet and a low-water depth of 6 feet from South Penobscot to Bridge Point. This includes dredging and removing rocks. The project also includes removing a small amount of rock in Johnson Narrows.

By act of August 11, 1888, Congress appropriated $3,000, and by act of September 19, 1890, the further sum of $4,000, for the improvement.

Previous to June 30, 1890, the sum of $100 had been expended for making plans, etc.

The amount now available is too small to carry on such a work to any advantage.

It may be found advisable to defer commencing work until the season of 1892, when, should a further appropriation be made, it may be added to funds now available.

The estimate for removal of rock alone is about $25,000, and this should be done before any dredging is commenced.

July 1, 1890, balance unexpended	$2,900.00
Amount appropriated by act approved September 19, 1890	4,000.00
July 1, 1891, balance unexpended	6,900.00

Amount (estimated) required for completion of existing project	$39,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	39,875.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 7.)

8. *Penobscot River, Maine.*—The appropriation of August 11, 1888, was divided by allotment into two parts; first, Bangor to Crosby Narrows, and second, between Bucksport and Winterport.

Above Crosby Narrows the former channel was too narrow to afford room to the numerous vessels and rafts, and between Bucksport and Winterport the channel was crooked and insufficiently deep.

The projects of improvement consist in widening the channel at Bangor and Crosby Narrows by dredging, and deepening the channel below by dredging and contraction works.

Amount expended to June 30, 1890:

Above Crosby Narrows	$35,426.87
Below Winterport	27,177.27

Expended in last fiscal year:

Above Crosby Narrows	14,813.15
Below Winterport	4,340.31
From appropriation, September 19, 1890	368.50
Total expenditure	82,126.10

The channel at Frankfort Flats, below Winterport, has been dredged to a depth of 22 feet over an average width of about 700 feet.

The widening at Bangor was completed in September, 1888. Dredging on the shoals above Crosby Narrows was commenced in June, 1890, and continued until compelled to suspend by ice. A small amount of dredging is still to be done under the contract.

The effect of this dredging is to widen the channel where it had become too narrow for easy navigation.

It has been considered advisable to expend the amount appropriated by act of September 19, 1890, in deepening the channel at High Head, above Bucksport, by dredging.

This work will be commenced as soon as arrangements can be conveniently made.

July 1, 1890, balance unexpended		$27,243.87
Amount appropriated by act approved September 19, 1890		25,000.00
		52,243.87
June 30, 1891, amount expended during fiscal year		22,659.89
July 1, 1891, balance unexpended		29,583.98
July 1, 1891, outstanding liabilities	$1,710.08	
July 1, 1891, amount covered by uncompleted contracts	2,829.60	
		4,539.68
July 1, 1891, balance available		25,044.30

Amount (estimated) required for completion of existing project	330,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 8.)

9. *Belfast Harbor, Maine.*—The river and harbor act of August 11, 1888, required an examination or survey of this harbor. Reports of the examination and survey were submitted and printed in House Ex. Doc.

No. 81, Fifty-first Congress, first session; also in Report of Chief of Engineers for 1890, page 455.

The project adopted for the improvement is to deepen the channel by dredging to a depth of 15 feet and adjacent areas to depths of 13 and 8 feet, respectively, at mean low water.

By act of September 19, 1890, Congress appropriated $10,000 for commencing the improvement.

Dredging the area of 8 feet depth was commenced in June under a contract; work under the contract will be completed before the close of the season.

July 1, 1890, balance unexpended		$1,985.99
Amount appropriated by act approved September 19, 1890		10,000.00
		11,985.99
June 30, 1891, amount expended during fiscal year		574.94
July 1, 1891, balance unexpended		11,411.05
July 1, 1891, outstanding liabilities	$1,823.38	
July 1, 1891, amount covered by uncompleted contracts	9,136.34	
		10,959.72
July 1, 1891, balance available		451.33
Amount (estimated) required for completion of existing project		42,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		42,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix A 9.)

10. *Camden Harbor, Maine.*—This harbor was so shoal that at low water vessels drawing more than 6 feet could not reach the wharves.

The project for improvement adopted in 1888 is as follows:

(1) Dredging approaches to depth of 12 feet.

(2) Dredging channels to depth of 10 feet.

(3) Removing middle ground.

Expenditures to June 30, 1890, $4,968.67.

As a result the channel on west side had been deepened to 10 feet at low water, 75 feet wide a distance of 1,150 feet, and 50 feet wide a further distance of 905 feet.

This is an assistance to vessels reaching the wharves, but the width is not sufficient for convenience.

A contract has been concluded for continuing dredging to widen the channel. The work will be completed as far as available funds permit before the close of season of 1891.

July 1, 1890, balance unexpended		$31.33
Amount appropriated by act approved September 19, 1890		6,000.00
		6,031.33
June 30, 1891, amount expended during fiscal year		62.50
July 1, 1891, balance unexpended		5,968.83
July 1, 1891, amount covered by uncompleted contracts		5,428.00
July 1, 1891, balance available		540.83
Amount (estimated) required for completion of existing project		49,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		49,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix A 10.)

11. *Rockport Harbor, Maine.*—This harbor is on the west side of Penobscot Bay, about 6½ miles above Rockland.

The upper portion of the harbor was shallow, so that the wharves could not be reached at low stages of tides.

The project for improvement consists in dredging the upper part to a depth of 12 feet at mean low water.

Previous to June 30, 1890, the amount expended was $9,986.81.

This resulted in deepening the upper part of harbor to 12 feet at mean low water over more than two-thirds the area included in the project.

Under appropriation of September 19, 1890, a contract has been concluded for completing the project by dredging and the removal of a small ledge of stone.

It is expected that the work will be completed before the end of the season of 1891.

The small amount expended in last fiscal year has been for advertising and other contingencies.

July 1, 1890, balance unexpended		$13.19
Amount appropriated by act approved September 19, 1890		5,000.00
		5,013.19
June 30, 1891, amount expended during fiscal year		102.00
July 1, 1891, balance unexpended		4,911.19
July 1, 1891, amount covered by uncompleted contracts		4,510.00
July 1, 1891, balance available		401.19

(See Appendix A 11.)

12. *Rockland Harbor, Maine.*—Originally this harbor was open to all easterly winds and seas, so that at such times the anchorage was unsafe and the seas often broke over the wharves.

The project for improvement adopted in 1881, and modified in 1890, consists in the construction of a breakwater to protect the anchorage, and form a harbor of refuge.

Estimated expense of the entire breakwater, $632,500.

The expenditures to June 30, 1890, were $152,500.

Expenditures in last fiscal year, $3,152.27.

As a result the breakwater had been extended 1,660 feet from low-water mark; 1,235 feet of the length from outer end has been raised to high-water level with a width of 20 feet on top. The remaining part next the shore is 12 feet wide on top and 5 feet above mean low water.

Under the appropriation of September 19, 1890, a contract has been made for extending the breakwater, and for modifying the old part near the shore.

The work of extending the breakwater was commenced in June under the contract, and will be carried on continuously as far as available funds will permit.

The completion of the project will result in a largely increased area for anchorage, and will make an excellent harbor of refuge.

Amount appropriated by act approved September 19, 1890		$37,500.00
June 30, 1891, amount expended during fiscal year		558.51
July 1, 1891, balance unexpended		36,941.49
July 1, 1891, outstanding liabilities	$2,593.76	
July 1, 1891, amount covered by uncompleted contracts	31,581.24	
		34,175.00
July 1, 1891, balance available		2,766.49

Amount (estimated) required for completion of existing project.....$442,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix A 12.)

13. *Kennebec River, Maine.*—The navigation of the river is much obstructed by ledges of rock and by shoals.

The project for improving the river consists in removing the shoals by contraction works and by dredging, and removing the ledges by blasting.

The estimated cost of the entire improvement was $410,500. This has been increased to $428,500, owing to the necessity for dredging at Beef Rock and Hatch's Rock shoals.

Amount expended to June 30, 1890, was $56,838.65.

Expended in last fiscal year, $66,811.47.

Total to June 30, 1891, $123,650.12.

The contraction works at Hatch's Rock have been completed, and a channel 100 feet wide has been dredged to a depth of 9 feet.

The jetty and training wall at Beef Rock are nearly completed, and a channel 150 feet wide and not less than 12 feet deep has been dredged through the bar.

Vessels can now pass the bar drawing more than 2 feet more water than before the improvement was commenced.

The piers at Hallowell are now being removed under a contract requiring the work to be completed August 1, 1891.

A survey of the harbor front at Bath has been made and harbor lines established.

The improvements upon the Kennebec River are of great importance to a very large commerce.

July 1, 1890, balance unexpended		$28,859.28
Amount appropriated by act approved September 19, 1890		50,000.00
		78,859.28
June 30, 1891, amount expended during fiscal year		63,890.71
July 1, 1891, balance unexpended		14,968.57
July 1, 1891, outstanding liabilities	$3,618.69	
July 1, 1891, amount covered by uncompleted contracts	2,423.00	
		6,041.69
July 1, 1891, balance available		8,926.88

Amount (estimated) required for completion of existing project..... 303,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 303,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix A 13.)

14. *Harraseeket River, Maine.*—In compliance with requirement of section 13 of the river and harbor act of August 11, 1888, an examination of this river was made and an estimate of the cost of an improvement was submitted by the officer in charge of the work. (See Report of Chief of Engineers, 1889, page 550.)

The project is to obtain a channel 60 feet wide and 14 feet deep at mean high water by dredging.

The estimated cost of the improvement is $36,000. Congress appropriated $10,000 for the work by act of September 19, 1890. This amount can not be expended in such a manner as to produce any benefit by itself.

It has therefore been considered best to withhold the expenditure until it may be made in connection with a further appropriation.

Amount appropriated by act approved September 19, 1890	$10,000.00
July 1, 1891, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	26,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	26,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 14.)

15. *Portland Harbor, Maine.*—Before the adoption of the present project for improvement there was but 21 feet of water to the wharves used by transatlantic steamers, and in the upper part of the harbor the depth at wharves in places did not exceed 12 feet.

The project for improvement consists in dredging a channel 500 feet wide and 29 feet deep at mean low water to the lower wharves and to deepen the channel to 16 feet in front of upper wharves.

Previous to June 30, 1890, there had been expended the sum of $68,308.23.

This has resulted in a channel 1,600 feet long and 400 feet wide along the wharf front, connected with deep water by a channel 2,800 feet long and 227 feet wide, all to a depth of 29 feet.

The heaviest laden steamers can now reach the wharves at the lowest stages of the tide, but a greater width is needed for entire safety.

Expended last fiscal year, $575.12.

The small amount expended in last fiscal year has been for advertising and other contingent expenses.

The act of September 19, 1890, having appropriated $40,000 for continuing the improvement, a contract has been made for widening the channel by dredging.

July 1, 1890, balance unexpended	$1,691.77
Amount appropriated by act approved September 19, 1890	40,000.00
	41,691.77
June 30, 1891, amount expended during fiscal year	575.12
July 1, 1891, balance unexpended	41,116.65
July 1, 1891, amount covered by uncompleted contracts	37,237.60
July 1, 1891, balance available	3,879.05
Amount (estimated) required for completion of existing project	30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 15.)

16. *Channel in Back Cove, Portland, Maine.*—Originally this channel was only navigable at high stages of water. A low-water depth of 8 to 10 feet extended over about half its length and parts of the remainder had a low-water depth not exceeding 1 foot.

The project for improvement adopted in 1886 consists in widening and deepening the channel to give a low-water depth of 12 feet and a width of 300 feet on the bottom for a distance of about 5,600 feet, following the harbor commissioners' line.

Amount expended to June 30, 1890, $50,974.40.

Amount expended in last fiscal year, $659.91.

The amount expended in last fiscal year has been for making a sur-

vey of part of the channel and for contingent expenses, advertising, etc., preparatory to resuming work under contract.

Under previous appropriations the channel has been extended a total distance of 4,050 feet to a depth of 12 feet and a width of 90 feet. A winding basin has also been dredged 400 feet wide.

This has resulted in largely increased facilities for business and in a large increase of the navigation.

Under the appropriation of September 19, 1890, a contract has been made for widening the channel by dredging.

July 1, 1890, balance unexpended	$275.60
Amount appropriated by act approved September 19, 1890	25,000.00
	25,275.60
June 30, 1891, amount expended during fiscal year	659.91
July 1, 1891, balance unexpended	24,615.69
July 1, 1891, amount covered by uncompleted contracts	22,500.00
July 1, 1891, balance available	2,115.69
Amount (estimated) required for completion of existing project	103,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 16.)

17. *Breakwater at mouth of Saco River, Maine.*—This breakwater was partially built in 1869 to 1873. In 1883 it was found necessary to complete the breakwater to the full height of 15 feet and top width of 12 feet, to secure the object of preventing the sand from drifting into the channel and maintaining a bar at the mouth of the Saco River.

There had been expended in repairing and raising the breakwater to June 30, 1890, the sum of $37,982.01.

The expenditures in the last fiscal year have been $2,017.99.

As a result the breakwater has been completed a distance of 2,320 feet from the outer end; and partially repaired a further distance of 28 feet.

While the completion of the breakwater is desirable it is at present less important than other improvements on the river.

As the act of September 19, 1890, made an appropriation for the Saco River including the breakwater, the balance estimated to complete the breakwater has been included in the estimate for Saco River.

July 1, 1890, balance unexpended	$4,872.81
June 30, 1891, amount expended during fiscal year	4,872.81

(See Appendix A 17.)

18. *Saco River, Maine.*—The channel was obstructed by a bar at the mouth, by shoals, and in one place by a ledge, and did not afford a continuous depth exceeding 3½ feet at mean low water, though much of the channel is very much deeper.

The project for improvement includes the works considered necessary to secure and maintain a channel having not less than 6 feet depth at mean low water to the head of tide water at Saco and Biddeford. It also includes the breakwater in accordance with provision of river and harbor act of September 19, 1890.

Amount expended to June 30, 1890, $20,978.99.

Expended in last fiscal year, $10,251.86.

As a result a ledge has been removed at Little Islands, a jetty and wall 750 feet long has been constructed above the islands, and part of

wing dam has been built at Cow Island. The channel has also been dredged in places, and a jetty has been commenced at the mouth of the river opposite the breakwater.

The channel has been much improved in places, but the removal of the bar at the mouth is essential to the use of vessels of greater draft.

It is expected that the jetty now commenced will greatly improve the bar.

July 1, 1890, balance unexpended		$2,353.46
Amount appropriated by act approved September 19, 1890		65,000.00
		67,353.46
June 30, 1891, amount expended during fiscal year		6,683.18
July 1, 1891, balance unexpended		60,670.28
July 1, 1891, outstanding liabilities	$3,969.51	
July 1, 1891, amount covered by uncompleted contracts	50,652.72	
		54,622.23
July 1, 1891, balance available		6,048.05
Amount (estimated) required for completion of existing project		97,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix A 18.)

19. *Kennebunk River, Maine.*—In compliance with requirements of the river and habor act of August 11, 1888, an examination and survey was made of a part of the river and an estimate of the cost of repairs to old piers and of constructing a small jetty was submitted. (House Ex. Doc. No. 136, Fifty-first Congress, first session. See also report of Chief of Engineers, 1890, pages 471 to 474.)

Congress appropriated $20,000 for the improvement by act of September 19, 1890.

The work of repair on the piers has been commenced and will be carried on continuously until the project is completed. No further appropriation is required.

Amount appropriated by act approved September 19, 1890	$20,000.00
June 30, 1891, amount expended during fiscal year	667.76
July 1, 1891, balance unexpended	19,332.24
July 1, 1891, outstanding liabilities	922.81
July 1, 1891, balance available	18,409.43

(See Appendix A 19.)

20. *York Harbor, Maine.*—The project for this improvement adopted in 1886 has for its object the widening of the channel in three bends where the low-water depth of 10 feet did not exceed 75 feet wide and where the tidal currents are very rapid.

Part of the material to be removed is a ledge of rock, and the remainder is a hard, sandy material united with small bowlders which can be dredged.

Expenditures to June 30, 1890, $16,528.90.

Expenditures in last fiscal year, $18,305.

Work under contract reported last year was completed February 25, 1891.

Under the appropriation of September 19, 1890, a contract was made for continuing the removal of ledge from point of Stage Neck. This was completed June 30, 1891. As a result the channel of 10 feet depth has been widened 65 feet, nearly doubling its original capacity.

The project contemplates an additional widening of 15 feet. The amount estimated to complete the project will accomplish all that is required.

July 1, 1890, balance unexpended	$10,727.70
Amount appropriated by act approved September 19, 1890	10,000.00
	20,727.70
June 30, 1891, amount expended during fiscal year	16,700.28
July 1, 1891, balance unexpended	4,027.42
July 1, 1891, outstanding liabilities	3,861.32
July 1, 1891, balance available	166.10
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 20.)

21. *Portsmouth Harbor, New Hampshire.*—The project for improving this harbor was adopted in 1879, the object being to check the strong tidal currents in the harbor and to give a navigable depth over the ledge known as Gangway Rock, opposite the navy-yard.

The river and harbor act of September 19, 1890, appropriated $13,000 for removal of Pier Rock, which is therefore added to the project.

Expenditures to June 30, 1890, $110,070.60.

Expenditures in last fiscal year, $4,437.78.

The results are the completion of the first project save a part of the ledge on point of Badger Island.

The work under contract before reported for removing this ledge is not yet completed. The funds for that purpose are sufficient to do all that is contemplated.

A contract has been made for removal of Pier Rock and the work is to be commenced in July, 1891.

No further appropriation is required.

July 1, 1890, balance unexpended		$12,114.20
Amount appropriated by act approved September 19, 1890		13,000.00
		25,114.20
June 30, 1891, amount expended during fiscal year		3,965.14
July 1, 1891, balance unexpended		21,149.06
July 1, 1891, outstanding liabilities	$657.44	
July 1, 1891, amount covered by uncompleted contracts	19,350.80	
		20,008.24
July 1, 1891, balance available		1,140.82

(See Appendix A 21.)

22. *Bellamy River, New Hampshire.*—This river is a tidal branch of Great Bay, which connects with the Piscataqua River, 4 miles above the bridge at Portsmouth.

The upper part was originally too shallow for navigation with any vessels of greater draft than flat boats.

The improvement consists in dredging the shallow part of channel to give a mean low-water depth of 5 feet, or about $11\frac{3}{4}$ feet at high water, which will permit vessels of about 500 tons to ascend to head of tide water.

Amount expended to June 30, 1890, $10,000.

Amount expended in last fiscal year, $111.52.

The expenditures of the last year have been for advertising and other contingencies preparatory to continuing work under contract.

Under the former contract the channel was dredged to full width and depth a distance of 4,950 feet.

A contract has been made for continuing the dredging as far as may be done with available funds.

Owing to various causes explained by the officer in charge of the work, it has been necessary to increase the estimate for completing the work to $15,000.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	111.52
July 1, 1891, balance unexpended	9,888.48
July 1, 1891, amount covered by uncompleted contracts	9,000.00
July 1, 1891, balance available	888.48
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 22.)

23. *Cocheco River, New Hampshire.*—Under provisions of section 13 of the river and harbor act of August 11, 1888, a survey of the river was made from Dover to the confluence with the Salmon Falls River, where the two form the Piscataqua River.

The officer in charge of the work submitted a project for deepening the channel to 7 feet at mean low water and giving a minimum width of 50 feet.

The present channel is 5 feet deep and has a minimum width of 40 feet.

Congress appropriated $25,000 for the improvement by act of September 19, 1890.

A contract has been made for dredging as far as may be done with available funds. It is expected that work under the contract will be completed in the season of 1891.

The expenditures have been for contingent preparatory work.

Amount appropriated by act approved September 19, 1890	$25,000.00
June 30, 1891, amount expended during fiscal year	215.29
July 1, 1891, balance unexpended	24,784.71
July 1, 1891, amount covered by uncompleted contracts	22,500.00
July 1, 1891, balance available	2,284.71
Amount (estimated) required for completion of existing project	150,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix A 23.)

24. *Harbor of refuge at Little Harbor, New Hampshire.*—This is a small harbor at the mouth of the Piscataqua River. It is the broad mouth of a small channel of the river itself. There is room for a considerable anchorage, but the water is too shallow save for small vessels. The ebb tides from the main channel are so rapid that in strong northerly winds it is impossible for sailing vessels to reach an anchorage in the river.

The object of the improvement is to form a refuge for coasters and fishing vessels in northeasterly storms when they can not get into Portsmouth Harbor.

The amount expended upon the improvement to June 30, 1890, was $30,000.

Amount expended last fiscal year, $4,639.10.

As a result the channel to a width of 100 feet, and the anchorage a width of 300 feet, has been dredged to a depth of 9 feet at low water. The breakwater from Frost Point has been commenced and the beacon on its outer end has been completed.

The work is being carried on under a contract with the lowest bidder after public advertisement for proposals.

The improvement thus far is of some benefit to a few small vessels, but is too limited to be available for a general refuge.

It is proposed to expend available funds and any further appropriation in completing the breakwater, and in deepening the channel and anchorage.

Amount appropriated by act approved September 19, 1890		$40,000.00
June 30, 1891, amount expended during fiscal year		3,442.44
July 1, 1891, balance unexpended		36,557.56
July 1, 1891, outstanding liabilities	$1,196.66	
July 1, 1891, amount covered by uncompleted contracts	31,325.81	
		32,522,47
July 1, 1891, balance available		4,035.09
Amount (estimated) required for completion of existing project		165,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix A 24.)

25. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the last fiscal year the following wrecks were removed under the provisions of the act of June 14, 1880: Schooner *Annie J. Russel*, from Portland Harbor, Maine; and the schooners *Golden Eagle* and *Cerulius* from Pleasant River, Maine.

(See Appendix A 25.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Smith, and reports thereon submitted. It is the opinion of Lieutenant-Colonel Smith, based upon the facts and reasons given, that these localities are not worthy of improvement. This opinion being concurred in by me, no further surveys of these localities were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Harbor of Bluehill, Maine, with especial reference to the removal of the ledges known as Middle Ground, eastern and western.*—Printed as House Ex. Doc. No. 19. (See also Appendix A 26.)

2. *Pepperell Cove, Maine, forming the eastern boundary of Portsmouth Lower Harbor.*—Printed as House Ex. Doc. No. 62. (See also Appendix A 27.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Smith, and reports thereon submitted. It is the opinion of Lieutenant-Colonel

Smith, based upon the facts and reasons given, that these localities are worthy of improvement. The reports of the preliminary examinations containing sufficient information to indicate to Congress the probable cost of the work required, no further surveys appear to be necessary at this time. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Lubec channel, Maine.*—The improvement proposed contemplates the excavation of a channel 500 feet wide at its narrowest place, increased to a width of 650 feet to make room in the bend, and 12 feet deep at mean low water, at an estimated cost of $231,000. Printed as House Ex. Doc. No. 158. (See also Appendix A 28.)

2. *Sullivan Falls, Hancock County, Maine, with a view to its improvement for navigation.*—The improvement proposed contemplates the removal of rock ledges near the Sullivan shore or Falls Point, so as to produce a clear channel 150 feet wide and 10 feet deep at mean low water, at an estimated cost of $35,000. Printed as House Ex. Doc. No. 84. (See also Appendix A 29.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Smith, and reports thereon submitted. It is the opinion of Lieutenant Colonel Smith, based upon the facts and reasons given, that these localities are worthy of improvement. This opinion being concurred in by me, Lieutenant-Colonel Smith was charged with their survey, the reports on which will be submitted when received.

1. *Penobscot River, Maine.*

2. *Kennebec River, from Waterville to steam-boat wharf at Augusta, Maine.*

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN MASSACHUSETTS.

Officer in charge, Lieut. Col. S. M. Mansfield, Corps of Engineers.

1. *Newburyport Harbor, Massachusetts.*—The object of the improvement is to create a channel through the outer bar 1,000 feet wide, and with a least depth of 17 feet at mean low water, or 24½ feet at mean high water.

The project, adopted in 1880 and modified in 1883, is to build two converging rubblestone jetties, so located as to give a proper direction to the current, and thereby produce and maintain the desired result. The estimated cost of the project was $375,000.

The original depth of water on the bar was 7 feet at mean low water.

To June 30, 1890, $231,101.25 had been expended, and the north jetty was 2,675 feet long, of which 2,200 feet were fully completed and 475 feet additional length were partly completed. The south jetty was 1,300 feet long, of which 1,077 feet were fully completed and 223 feet built up to low water.

The Plum Island Dike was 817 feet long, 5½ feet high above mean low water, except near the center, where a weir is left temporarily 150 feet long and 2 feet above mean low water.

The sand catch in rear of the south jetty was in two branches, one 480 feet long and one 572 feet.

All these works were in good order.

During the fiscal year 4,279 tons of stone were deposited in the north jetty, at an expense of $7,143.56. It is at the date of this report 2,300 feet long, fully completed, and 375 feet more have been partly completed.

On June 30, 1891, the south jetty, the Plum Island Dike, and the sand catch remain in the same condition as at the date of the last report.

A survey of the bar was made in May, 1891; it showed that the channel on the bar had straightened, widened, and deepened since the survey of 1890. It is now not less than 12.2 feet deep in a straight channel at least 300 feet wide.

The advantages to be derived from the completion of the project are the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach, and also affording easy access at high water to the wharves at Newburyport for vessels drawing 17 feet, approximately.

July 1, 1890, balance unexpended		$1,398.75
Amount appropriated by act approved September 19, 1890		25,000.00
		26,398.75
June 30, 1891, amount expended during fiscal year		3,611.50
July 1, 1891, balance unexpended		22,787.25
July 1, 1891, outstanding liabilities	$3,532.06	
July 1, 1891, amount covered by uncompleted contracts	8,409.87	
		11,941.93
July 1, 1891, balance available		10,845.32
Amount (estimated) required for completion of existing project		117,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		117,500.00

Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 1.)

2. *Merrimac River, Massachusetts.*—The object of the improvement is to straighten, deepen, and widen the natural channel of the river from its mouth to the Upper Falls, a distance of 21½ miles.

The channel originally was narrow, crooked, and much obstructed by ledges, bowlders, and shoals; and below Newburyport by ledges, cribs, piers, and wrecks.

At mean low water vessels drawing not to exceed 7 feet could cross the bar and proceed about 6 miles above Newburyport.

The mean rise or fall of the tide at the mouth of the river is 7½ feet; at Haverhill Bridge, 4 feet.

The project, originally adopted in 1870, proposed to remove obstructions from the Upper and Lower Falls, to remove Gangway Rock, to remove the wreck of the *Globe*, and to remove the "Boilers."

The cost was estimated at $69,025.

This project was revised and extended in 1874 to include the removal of rocks at Deer Island and Rock Bridges, and at Little Curriers Shoal, so that the channel should have the following depths at ordinary high-water stages of the river: From the mouth to Deer Island Bridge (5 miles), 16½ feet; from Deer Island Bridge to Haverhill Bridge (12½ miles), 12 feet; thence to the foot of Mitchell Falls (1½ miles), 10 feet; through Mitchell Falls to the head of the Upper Falls (2½ miles), not less than 4½ feet, with the mill water at Lawrence running. This revised project was estimated to cost $147,000.

The total expenditures to June 30, 1890, were $170,500, and the river channel had been improved in accordance with the modified project, with the exception of the removal of the "Boilers," upon which no work has been done.

No operations were in progress during the year, and the improvement remains in good order.

To complete the improvement so that the same depth of water which has been obtained through Mitchell Falls can be carried to Lawrence, additional work will be required at the falls above Haverhill, which is estimated to cost $11,000; and additional improvements could be made in the lower part of the river which are estimated to cost $11,500, or a total of $22,500.

The improved channel is in good order.

Amount appropriated by act approved September 19, 1890	$10,000.00
July 1, 1891, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	1,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 2.)

3. *Powow River, Massachusetts.*—Powow River is a tributary of the Merrimac River, into which it enters from the north about 3½ miles above Newburyport.

From the mouth, tide water extends 9,600 feet in a narrow, crooked channel, not navigable at low water.

The project proposed for its improvement is to dredge a channel 9,600 feet long, 60 feet wide, and 12 feet deep at mean high water, at an estimated cost of $77,000.

The river and harbor acts of 1888 and 1890, appropriated $8,000 for this work, provided a suitable draw was built in the bridge which now crosses the mouth of the river.

Action is in progress by the town authorities, having in view compliance with this proviso.

No expenditures were made during the year ending June 30, 1891, and the original condition of the river is unaltered.

July 1, 1890, balance unexpended	$3,000.00
Amount appropriated by act approved September 19, 1890	5,000.00
July 1, 1891, balance unexpended	8,000.00
Amount (estimated) required for completion of existing project	69,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 3.)

4. *Ipswich River, Massachusetts.*—Ipswich River empties into Plum Island Sound about 9 miles south of Newburyport, Mass. It is navigable from its mouth to the wharves at Ipswich, a distance of 3 miles. Before improvement, at low water, not to exceed 1½ feet draft could be carried in a narrow channel.

The mean rise or fall of the tide is 8.4 feet.

The object of the improvement is to widen and deepen the natural channel of the river.

The original project was submitted in 1875. It proposed a channel 60 feet wide and 4 feet deep at mean low water.

No expenditures were made during the fiscal year.

Sealed proposals were invited by circular letter dated September 27, 1889, for the completion of the present partial project. No bids were received in response.

On April 10, 1890, bids were again invited by circular letter, and two

proposals were received. Both were rejected, as the lowest would make the improvement cost at least twice the amount available, and no advantage to commerce would result from its partial completion.

The work of completing this improvement as now proposed has been publicly advertised three times and it is evident that the small amount of work to be done in this locality, so difficult of access, will cost more than similar work in more accessible places.

The condition of the improvement June 30, 1891, is the same as on June 30, 1889.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1890, balance unexpended	$2,462.92
July 1, 1891, balance unexpended	2,462.92
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 4.)

5. *Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.*—This bay is situated at the northeastern extremity of Cape Ann, Massachusetts. It is open to the full effect of easterly and northeasterly gales.

The proposed improvement contemplates the construction of a national harbor of refuge of the first class. The anchorage covered by the proposed breakwater will contain 1,377 acres.

The estimated cost of the improvement is $5,000,000.

The expenditures to June 30, 1890, were $287,765.56.

The condition of the improvement on June 30, 1890, was as follows:

Two hundred and fifty-two thousand nine hundred and thirty-four tons of rubblestone had been deposited in the substructure of the breakwater, essentially completing it between crossranges 140 and 3540.

During the fiscal year 54,239 tons of rubblestone were deposited in the substructure of the breakwater by contract, at a cost of $49,178.30, essentially completing it between crossranges 140 and 3740.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased safety to life and property, and a consequent reduction in freights and insurance.

July 1, 1890, balance unexpended		$26,856.93
Amount appropriated by act approved September 19, 1890		150,000.00
		176,856.93
June 30, 1891, amount expended during fiscal year		49,178.30
July 1, 1891, balance unexpended		127,678.63
July 1, 1891, outstanding liabilities	$10,913.16	
July 1, 1891, amount covered by uncompleted contracts	96,109.34	
		107,022.50
July 1, 1891, balance available		20,656.13
Amount (estimated) required for completion of existing project		4,550,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		250,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 5.)

6. *Gloucester Harbor, Massachusetts.*—Gloucester Harbor is an important center for the fishing fleet of New England, about 20 miles north of Boston. Its inner harbor was originally obstructed by sunken rocks and shoals, preventing free movement of vessels, and the ap-

proaches to the wharves were shallow, varying from 1 to 12 feet. The outer harbor was open to all southerly winds.

The first project submitted in compliance with the act of July 11, 1870, proposed to clear the harbor of sunken rocks and to build a stone breakwater from Eastern Point to Round Rock Shoal. The operations in execution of this general project, under the acts of July 11, 1870, and June 10, 1872, have been confined solely to the removal of isolated sunken rocks specially obstructive to the navigation of the inner harbor.

The act of June 10, 1872, appropriated $10,000, which sum was applied to the removal of Clam Rock, Pinnacle Rock, rock off J. Friend's Wharf, rock off Pew's Wharf, and a portion of Babson Ledge.

The act of August 5, 1886, appropriated $5,000 for a survey of the harbor and for continuing work on Babson Ledge.

The survey was completed in December, 1886, and a report and general project based on this survey were published in the Report of the Chief of Engineers for 1887, page 500.

The revised project proposed to remove from the inner harbor 101½ cubic yards of rock, known to exist, and 216,000 cubic yards, scow measurement, of material, at an estimated cost of $65,000; and to construct the breakwater that extends from Eastern Point to Round Rock Shoal, recommended in the project of 1884, at an estimated cost of $752,000.

The amount expended to June 30, 1890, was $24,580.84.

On June 30, 1890, the condition of the improvement was as follows:

Clam Rock, Pinnacle Rock, rock off J. Friend's Wharf, and rock off Pew's Wharf had been reduced to the level of the surrounding bottom, and Babson Ledge to 14 feet at mean low water. Two channels of approach to the wharves in Harbor Cove had been dredged; each was 40 feet wide and 10 feet deep at mean low water; the eastern one was 550 feet long, the western 1,000 feet long.

During the fiscal year a contract was entered into to dredge 40,000 cubic yards. This contract expires December 31, 1891.

No operations were in progress during the fiscal year, and the condition of the improvement remains unchanged.

July 1, 1890, balance unexpended	$419.16
Amount appropriated by act approved September 19, 1890	15,000.00
	15,419.16
June 30, 1891, amount expended during fiscal year	67.76
July 1, 1891, balance unexpended	15,351.40
July 1, 1891, amount covered by uncompleted contracts	8,800.00
July 1, 1891, balance available	6,551.40
Amount (estimated) required for completion of existing project	792,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	305,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 6.)

7. *Manchester Harbor, Massachusetts.*—Manchester Harbor is situated about 5½ miles northeast from the entrance of Salem Harbor, Massachusetts.

Its outer roadstead contains 300 acres approximately, with 5 fathoms of water. Its entrance channel is 100 feet wide and 6½ feet deep at mean low water up to Proctor Point; it then shoals rapidly to a depth of 1½ feet at the "Narrows," 1,400 feet from Proctor Point, and for a further distance of 2,500 feet to the town wharves no low-water channel exists.

The project for its improvement is based on the survey provided for in the act of August 5, 1886. It proposes to dredge a channel from Proctor Point to the town wharves, 4,000 feet long, 60 feet wide, and 4 feet deep at mean low water, at an estimated cost of $14,300.

The total appropriations for this improvement to date have been $7,500.

The expenditures to June 30, 1890, were $109.07 and the original condition of the harbor was unchanged.

During the fiscal year a contract, which expires December 31, 1891, was entered into to dredge 22,000 cubic yards, making a channel 35 feet wide and 4 feet deep at mean low water from Proctor Point to the railroad bridge.

Operations under this contract were commenced early in June, 1891, and at the close of the fiscal year 7,316 cubic yards had been dredged.

The condition of the improvement is essentially the same as on June 30, 1890.

July 1, 1890, balance unexpended		$2,390.93
Amount appropriated by act approved September 19, 1890		5,000.00
		7,390.93
June 30, 1891, amount expended during fiscal year		212.40
July 1, 1891, balance unexpended		7,178.53
July 1, 1891, outstanding liabilities	$2,121.64	
July 1, 1891, amount covered by uncompleted contracts	4,258.36	
		6,380 00
July 1, 1891, balance available		798.53
Amount (estimated) required for completion of existing project		6,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1893.		6,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix B 7.)

8. *Salem Harbor, Massachusetts.*—Salem Harbor is 12 miles northward of Boston, Mass. It contains a well-sheltered, entirely unobstructed anchorage of about 110 acres, more than 18 feet deep at mean low water.

The principal city wharves are located on South River, a small stream entering the harbor. This river is 3,000 feet long, from 150 to 300 feet wide and not navigable at low tide.

The original project for the improvement of this harbor was submitted December 16, 1872. It proposed to dredge a channel of approach to the mouth of South River, 1,730 feet long, 300 feet wide, and 8 feet deep at mean low water. This project was essentially completed in 1873–'75.

The present project was submitted December 2, 1889. It proposed to clear out the channel as originally dredged, and to extend it to the head of navigation, gradually reducing its width from 150 feet, at the mouth of the river, to 100 feet near the inner end of Derby Wharf, and above this to excavate a channel 50 feet wide. To the inner end of Derby Wharf the improved channel to be 8 feet deep at mean low water and above this point 6 feet deep. The total length of the improved channel to be 5,100 feet approximately.

The total appropriations to date have been $39,000.

The expenditures to June 30, 1890 were $25,000. At that date the entrance channel dredged in 1873–1875 had essentially preserved its original dimensions.

During the fiscal year a contract which expires December 31, 1891, was entered into to dredge 50,000 cubic yards. No operations were in progress during the fiscal year under this contract and the condition of the improvement at the date of this report is the same as on June 30, 1890.

Amount appropriated by act approved September 19, 1890	$14,000.00
June 30, 1891, amount expended during fiscal year	73.65
July 1, 1891, balance unexpended	13,926.35
July 1, 1891, amount covered by uncompleted contracts	11,000.00
July 1, 1891, balance available	2,926.35

Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	14,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 8.)

9. *Lynn Harbor, Massachusetts.*—The object of this improvement is to obtain a more direct, wider, and deeper channel of approach to the city wharves. The original channels were narrow and crooked and had but 6 feet depth at mean low water, and the greater part of the harbor was bare at low water.

The project was adopted in 1884. It proposed a channel 200 feet wide and 10 feet deep at mean low water through the outer and inner bars. The outer channel is 3,610 feet long, the inner one 6,450 feet. It is supposed that the inner channel will need occasional dredging. To aid in keeping the outer channel open a training wall is proposed, if experience shall show it to be necessary.

On September 24, 1888, it was proposed to extend the inner channel 400 feet within the harbor line and to excavate at its inner end an anchorage basin 500 by 300 feet in area, 10 feet deep at mean low water, at an estimated cost of $25,000.

The cost of the original project was estimated to be $157,000.

The total expenditures to June 30, 1890, were $75,415.32, of which $66,000 had been expended on the original project.

The condition of the improvement June 30, 1890, was as follows:

The outer channel is 3,610 feet long, 200 feet wide, 10 feet deep at mean low water; the inner channel is 6,450 feet long, 150 feet wide, 10 feet deep; the anchorage basin is 125 feet wide, 500 feet long, 10 feet deep, connected with the inner channel by a cut 400 feet long, 100 feet wide, 10 feet deep. Nothing has been done on the training wall.

During the fiscal year a contract which expires December 31, 1891, was entered into to dredge 40,000 cubic yards from the interior basin, thus completing it.

No operations were in progress under this contract during the fiscal year, and the condition of the improvement remains as on June 30, 1890.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1890, balance unexpended	$584.68
Amount appropriated by act approved September 19, 1890	15,000.00
	15,584.68
June 30, 1891, amount expended during fiscal year	197.04
July 1, 1891, balance unexpended	15,387.64
July 1, 1891, amount covered by uncompleted contracts	7,200.00
July 1, 1891, balance available	8,187.64

Amount (estimated) required for completion of existing project	$91,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 9.)

10. *Winthrop Harbor, Massachusetts.*—Winthrop Harbor is situated in the northeastern part of Boston Harbor. It contains 350 acres, approximately, all of which is essentially dry at low tide. The mean range of tides is 9.4 feet.

The original project for its improvement was based on the survey provided for in the act of August 5, 1886. It proposed to dredge a straight channel 3,900 feet long, 50 feet wide, 6 feet deep at mean low water, from the "Back" channel of Boston Harbor to Rice's Wharf.

The total appropriations to date for this improvement have been $6,000.

No expenditures were made previous to June 30, 1890, and the original condition of the harbor then remained unaltered.

During the fiscal year a contract, which expired June 30, 1891, was entered into to dredge 20,000 cubic yards.

Operations under this contract were commenced early in May, 1891, and it was satisfactorily completed during the latter part of June, 1891, by the removal of 20,060 cubic yards.

At the date of this report the improved channel is 35 feet wide, 3 feet deep at mean low water, 3,900 feet long.

July 1, 1890, balance unexpended		$1,000.00
Amount appropriated by act approved September 19, 1890		5,000.00
		6,000.00
July 30, 1891, amount expended during fiscal year		2,381.18
July 1, 1891, balance unexpended		3,618.82
July 1, 1891, outstanding liabilities		2,944.82
July 1, 1891, balance available		674.00
Amount (estimated) required for completion of existing project	11,600.00	
Amount that can be profitably expended in fiscal year ending June 30, 1893	11,600.00	
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix B 10.)

11. *Boston Harbor, Massachusetts.*—The object of this improvement is, first, to preserve the harbor by protecting the islands and head lands and, second, to improve it by widening, straightening, and deepening the channels.

The projects adopted for this purpose since 1866 have been mainly in accordance with the recommendations of the United States Commissioners, whose labors terminated during that year.

The works of preservation consist of sea-walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads. Such have been built or repaired at Point Allerton and the islands of Great Brewster, Lovell, Gallop, Long, Deer, Rainsford, George, and Castle.

The works of improvement have been by dredging and blasting, by which means many dangerous rocks and shoals have been removed and the main ship channel enlarged from 100 feet wide and 18 feet deep at mean low water so that it is now at least 625 feet wide and 23 feet deep at mean low water, except off the west end of Brewster Spit,

which has grown westward so that on July 1, 1890, the channel was but 475 feet wide.

The following tributary channels have also been improved:

(*a*) *Charles River.*—The natural channel of this river has been widened, straightened, and deepened, so that from its mouth up to Western Avenue Bridge, a distance of $4\frac{3}{4}$ miles, the channel has a width of 200 feet and a depth of 7 feet at mean low water; thence to Arsenal Street Bridge, $2\frac{1}{2}$ miles, the channel has a least width of 80 feet and a least depth of 6 feet.

(*b*) *Fort Point Channel.*—This important branch of the main ship-channel had a least depth of 12 feet at its entrance, and the channel was narrow and crooked. It has been widened to 175 feet and deepened to 23 feet at mean low water from its mouth to Congress Street Bridge, a distance of 1,900 feet.

(*c*) *Hingham Harbor.*—(See separate report.)

(*d*) *Nantasket Beach Channel.*—The project adopted in 1880 was to widen and deepen the channel so that it would be at least 100 feet wide and $9\frac{1}{2}$ feet deep at mean low water. The project was completed in 1881 and 1883.

(*e*) *Channel between Nix's Mate and Long Island.*—This channel had originally $4\frac{1}{2}$ feet depth at mean low water. A cut has been made through the bar 200 feet wide, 550 feet long, and 12 feet deep at mean low water.

(*f*) *Broad Sound.*—An obstruction called Barrel Rock was removed in 1869. The total expenditures to June 30, 1890, were $1,728,360.66.

During the fiscal year ending June 30, 1891, contracts were entered into for dredging from the channel leading to Nantasket Beach; from the channel between Nix's Mate and Long Island; from Brewster Spit; and from the main ship channel leading to Jeffrey Point. The extension of Gallop Island sea-wall and the repairs of the Great Brewster Island sea-wall were commenced.

The contract for dredging from Nantasket Beach was completed during the fiscal year, and that for dredging at Brewster Spit well advanced towards completion.

At the date of this report the several works of preservation are in fair order; the main ship-channel is 23 feet deep at mean low water, 1,100 feet wide west of the Upper Middle, 750 feet wide at the Upper Middle, 1,000 feet wide at the Lower Middle, and at least 625 feet elsewhere, except off Brewster Spit, where it is 550 feet approximately.

The subsidiary channels are in the same condition as at date of the last report, with the exception of the one leading to Nantasket Beach where it is now at least 150 feet wide, $9\frac{1}{2}$ feet deep at mean low water, except over a small ledge uncovered by the dredging of the year, near the steamboat wharf.

July 1, 1890, balance unexpended		$27,747.84
Amount appropriated by act approved September 19, 1890		145,000.00
		172,747.84
June 30, 1891, amount expended during fiscal year		15,921.72
July 1, 1891, balance unexpended		156,826.12
July 1, 1891, outstanding liabilities	$6,621.53	
July 1, 1891, amount covered by uncompleted contracts	37,023.40	
		43,644.93
July 1, 1891, balance available		113,181.19

Amount (estimated) required for completion of existing project $390,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 390,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 11.)

12. *Weymouth River, Massachusetts.*—Weymouth (Fore) River empties into the southwestern part of Boston Harbor, Massachusetts. For 4 miles it is navigable at low water for vessels drawing 18 feet, and to the head of navigation, an additional 3 miles, at least 3 feet depth is to be found.

The original project for its improvement was submitted December 2, 1889. It proposed to improve the natural channel, so that 6 feet at mean low water could be carried to the head of navigation in a channel 100 feet wide to near Weymouth Landing, thence to Braintree Bridge, 80 feet wide, and above the bridge 50 feet wide. The total length of improved channel to be 7,000 feet, and to cost $40,000.

The river and harbor act of September 19, 1890, appropriated for this work $10,000.

During the fiscal year 18,389 cubic yards were dredged, and the improved channel at the date of this report is 5,000 feet long, 40 feet wide, and 6 feet deep at mean low water.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		4,468.46
July 1, 1891, balance unexpended		5,531.54
July 1, 1891, outstanding liabilities	$3,110.81	
July 1, 1891, amount covered by uncompleted contracts	2,104.13	
		5,214.94
July 1, 1891, balance available		316.60

Amount (estimated) required for completion of existing project 30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 12.)

13. *Hingham Harbor, Massachusetts.*—The object of this improvement is to widen and deepen the natural channel, which was 30 feet wide and 4 feet deep, so that it will be 100 feet wide and 10 feet deep at mean low water.

The project was originally proposed in 1874 and was modified in 1885. The original project was estimated to cost $11,000. The project of 1885 was to cost an additional sum of $18,750.

The total appropriations to date have been $26,000, and the expenditures to June 30, 1890, were $20,944.99.

On June 30, 1890, the improved channel through the ledge northeast of steamboat wharf was 100 feet wide, 10 feet deep at mean low water, and the remainder of its length was 8 feet deep.

During the fiscal year a contract was entered into to dredge 20,000 cubic yards. Operations were commenced under this contract early in May, 1891, and was satisfactorily completed in June, 1891, by the removal of 20,400 cubic yards.

At the date of this report the improved channel is 100 feet wide, 10 feet deep at mean low water.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1890, balance unexpended	$5.01
Amount appropriated by act approved September 19, 1890	5,000.00
	5,005.01
June 30, 1891, amount expended during fiscal year	4,093.36
July 1, 1891, balance unexpended	911.65
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	3,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 13.)

14. *Scituate Harbor, Massachusetts.*—This harbor is on the west shore of Massachusetts Bay, about 14 miles south of Boston light.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston from the eastward which are too far south of their true course to clear the dangerous ledges near Minot's Ledge light.

Originally the harbor had a low-water area of about 57 acres, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of easterly gales, and its entrance was obstructed by sunken bowlders.

The project adopted in 1880 is to build two breakwaters, one from Cedar Point, on the north side of the entrance, and the other from the First Cliff, on the south side, and to dredge the area inclosed and in front of the entrance. The estimated cost of the improvement is $290,000.

The expenditures to June 30, 1890, were $51,670.20.

The condition of the improvement on June 30, 1890, was as follows:

The north breakwater was essentially completed. Nothing had been done on the south breakwater. The anchorage basin was 350 by 450 in area, 7 feet deep at mean low water. The entrance channel was 1,600 feet long, 100 feet wide, 5 feet deep at mean low water. The channel connecting the basin with the town wharves was 2,100 feet long, 25 feet wide, 1 foot deep at mean low water.

During the fiscal year a contract, which expires December 31, 1891, was entered into to dredge 30,000 cubic yards from the channel leading from the basin to the town wharves.

No operations were in progress under this contract during the fiscal year and the condition of the improvement at the date of this report is the same as on June 30, 1890.

The prospective benefits to commerce by the completion of this improvement are the creation of an additional harbor of refuge on this much-frequented dangerous coast.

July 1, 1890, balance unexpended	$829.80
Amount appropriated by act approved September 19, 1890	10,000.00
	10,829.80
June 30, 1891, amount expended during fiscal year	68.57
July 1, 1891, balance unexpended	10,761.23
July 1, 1891, amount covered by uncompleted contracts	9,750.00
July 1, 1891, balance available	1,011.23
Amount (estimated) required for completion of existing project	227,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 14.)

15. *Plymouth Harbor, Massachusetts.*—Plymouth Harbor is 30 miles south of Boston.

The object of its improvement is to perpetuate the harbor by the preservation of Long Beach which forms it, and to deepen and widen the channels of approach to an enlarged anchorage basin in front of the town wharves.

The various devices employed for the preservation of Long Beach are described in the Annual Report of the Chief of Engineers for the year 1877.

The original project for improvement was adopted in 1875 and modified in 1877 and 1884. The modified project proposed an improved channel 2,286 feet long, 150 feet wide, and 9 feet deep at mean low water, leading to an anchorage basin 866 feet long, 150 feet wide, and 9 feet deep at mean low water.

From 1866 to date, $128,800 has been appropriated for this harbor.

The expenditures to June 30, 1890, were:

For beach protection	$76,915.48
Dredging	42,556.84
Total	119,472.32

At that date the entrance channel was 115 feet wide and 9 feet deep at mean low water. The basin was 800 feet long, averaged 150 feet wide and 9 feet deep at mean low water. The works protecting Long Beach were in fair order.

During the fiscal year a contract, which expires December 31, 1891, was entered into, to dredge 18,000 cubic yards from the channel and basin. Operations under this contract were commenced during the latter part of June, 1891, and during the fiscal year 6,918 cubic yards was removed. At the date of this report the improved channel is 130 feet wide, and the basin is essentially the same as on June 30, 1890.

The prospective benefits to commerce are increased facilities and safety to navigation.

July 1, 1890, balance unexpended		$1,327.68
Amount appropriated by act approved September 19, 1890		8,000.00
		9,327.68
June 30, 1891, amount expended during fiscal year		156.29
July 1, 1891, balance unexpended		9,171.39
July 1, 1891, outstanding liabilities	1,867.86	
July 1, 1891, amount covered by uncompleted contracts	2,992.14	
		4,860.00
July 1, 1891, balance available		4,311.39
Amount (estimated) required for completion of existing project		9,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		9,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B 15.)

16. *Wellfleet Harbor, Massachusetts.*—Wellfleet Harbor is 12 miles southeast of Provincetown, on Cape Cod Bay.

The object of its improvement is to provide a navigable channel from the inner anchorage, the "Deep Hole," to the town wharves.

The project originally proposed in 1871 was to dredge two channels of approach to the town wharves and to remove several dangerous sunken rocks.

The removal of the sunken rocks was effected by an appropriation provided by the act of June 10, 1872.

The present project is to dredge a channel from the "Deep Hole" to

the town wharves 4,200 feet long, 100 feet wide, and 6 feet deep at mean low water.

The expenditures to June 30, 1890, were $11,339.79.

The condition of the improvement on that date was as follows:

Two hundred and four cubic yards of rocks had been removed from the harbor, and the channel connecting the "Deep Hole" with the town wharves was 25 feet wide, 4 feet deep at mean low water.

No operations were in progress during the fiscal year, as the funds available were considered not sufficient to give any appreciable benefit to commerce.

The condition of the improvement at the date of this report is the same as on June 30, 1890.

July 1, 1890, balance unexpended	$660.21
Amount appropriated by act approved September 19, 1890	4,000.00
	4,660.21
June 30, 1891, amount expended during fiscal year	10.58
July 1, 1891, balance unexpended	4,649.63
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 16.)

17. *Provincetown Harbor, Massachusetts.*—Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light. It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England, and a very large local fishing interest are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand catches, and extensive planting of beach grass to repair and prevent storm damages to the beaches.

From the nature of the work it can at no time be considered completed. A special dike across Howse Point Island Flats to be built contingently, was recommended in the annual report for 1886.

A plan of the harbor was published in the annual report of the Chief of Engineers for 1886.

The amount expended to June 30, 1890, was $143,063.66 and the several works for protection were in good order, but an additional bulkhead was required to strengthen the weak central portion of Long Point.

During the fiscal year materials were collected and the construction of a bulkhead 2,000 feet long was commenced to protect Long Point, about 2,000 feet west of Wood End Light.

At the date of this report the works of preservation are in good order. But additional protection is required at the east end of Long Point, to secure the light-house tract.

July 1, 1890, balance unexpended	$3,414.78
Amount appropriated by act approved September 19, 1890	7,500.00
	10,914.78
June 30, 1891, amount expended during fiscal year	2,081.81
July 1, 1891, balance unexpended	8,832.97
July 1, 1891, outstanding liabilities	3.00
July 1, 1891, balance available	8,829.97

Amount (estimated) required for completion of existing project	$1,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,500. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B 17.)

18. *Chatham Harbor, Massachusetts.*—Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Mass.

Its outer anchorage (Chatham Roads) is a valuable harbor of refuge from northerly and easterly gales. The inner harbor (Stage Harbor) is small, but well landlocked, and has 8 to 12 feet depth at mean low water. Its entrance is obstructed by three bars on which the greatest depth at mean low water is 4 feet.

During the fiscal year a survey of the harbor was made, and a project submitted for its improvement.

The project for the improvement of this harbor submitted December 19, 1890, proposes to dredge a channel through the three obstructing bars, 6 feet deep at mean low water, 100 feet wide at the inner bar, 150 feet at the middle bar, and 200 feet wide at the outer bar, at a cost of $10,000.

The total appropriations to date have been $5,000 by the river and harbor act of September 19, 1890.

It was estimated that the funds available would dredge a channel 6 feet deep and 100 feet wide through the three bars.

An advertisement calling for bids for the proposed work was issued, but the proposals received were rejected as excessive.

The work will be again advertised.

Amount appropriated by act approved September 19, 1890	$5,000. 00
June 30, 1891, amount expended during fiscal year	398. 81
July 1, 1891, balance unexpended	4,601. 19

Amount (estimated) required for completion of existing project	5,000. 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000. 00
Submitted in compliance with requirements of sections 2 of the river and harbor acts of 1866 and 1867.	

(See Appendix B 18.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Mansfield, and reports thereon submitted. It is the opinion of Lieutenant-Colonel Mansfield, based upon the facts and reasons given, that these localities are not worthy of improvement, and this opinion being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *North River, Salem, Massachusetts, from Beverly Bridge to the North Street Bridge.*—Printed as House Ex. Doc., No. 28. (See also Appendix B 19.)

2. *Shoals at the mouth of North River, Massachusetts, with a view of removing the same and other obstructions.*—Printed as House Ex. Doc. No. 20. (See also Appendix B 20.)

The required preliminary examination of *Mystic River, Massachusetts and the Malden River, a tributary of the Mystic, from the bridge of the Boston and Maine Railroad, eastern division, to the head of navigation on said rivers*, was made by the local engineer in charge, Lieutenant-Colonel Mansfield, and report thereon submitted. It is the opinion of Lieutenant-Colonel Mansfield, based upon the facts and reasons given, that these rivers are worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of work required on Malden River, no further survey of this river appears to be necessary at this time. The proposed improvement of Malden River contemplates the completion of the approved project for excavating a channel 12 feet deep and 100 feet wide up to the first bridge, and thence 75 feet wide up to the second bridge; the estimated cost of completing this work is $37,000. The opinion of Lieutenant-Colonel Mansfield in regard to Mystic River being concurred in by me, he was charged with and has completed its survey and submitted his report thereon. The proposed improvement of Mystic River contemplates the enlargement of the natural channel to a width of 100 feet and depth of 6 feet, at mean low water, to the first turn above Dennings Wharf, and thence to the head of navigation to a depth of 4 feet and with a width gradually reduced to 50 feet at Cradock Bridge; the cost of this work is estimated at $25,000. (See appendix B 21.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Mansfield, and reports thereon submitted. It is the opinion of Lieutenant-Colonel Mansfield, based upon the facts and reasons given, that these localities are worthy of improvement. This opinion being concurred in by me, Lieutenant-Colonel Mansfield was charged with and has completed their survey and submitted reports thereon:

1. *Essex River, Massachusetts.*—The improvement proposed contemplates widening and deepening the channel to a width of 60 feet and depth of 4 feet at mean low water to the head of navigation, at an estimated cost of $25,000. (See Appendix B 22.)

2. *Town River, Massachusetts.*—The improvement proposed contemplates the enlargement of the natural channel from the head of navigation to a point 4,500 feet below, to a width of 100 feet and a depth of 4 feet at mean low water; this will require the removal, by dredging, of 80,000 cubic yards of material, and is estimated to cost $20,000. Report transmitted to Congress and printed as House Ex. Doc. No. 155, Fifty-first Congress, second session. (See also Appendix B 23.)

3. *Weymouth Back River, Massachusetts.*—The proposed improvement contemplates the dredging of a channel 200 feet wide and 12 feet deep at mean low water through the bar at the mouth of the river, and the enlargement of the natural channel to the same dimensions up to the wharf of the Bradley Fertilizer Company; the cost is estimated at $22,000. Report transmitted to Congress and printed as House Ex. Doc. No. 256, Fifty-first Congress, second session. (See also Appendix B 24.)

4. *Kingston Harbor, Massachusetts, with a view to its improvement.*—The improvement proposed contemplates the excavation of a channel 100 feet wide and 6 feet deep at mean low water up to the wharf of the Plymouth Cordage Company, at an estimated cost of $10.000. (See Appendix B 25.)

IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHERN COAST OF MASSACHUSETTS, AND IN RHODE ISLAND; AND OF STONINGTON HARBOR, CONNECTICUT.

Officer in charge, Maj. W. R. Livermore, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Harbor of refuge at Hyannis, Massachusetts.*—This harbor, before improvement, was an open roadstead, exposed to southerly storms. In the years 1827–1838 a breakwater of riprap granite 1,170 feet long was constructed, covering an anchorage of about 175 acres, the entrance to which has a depth of about 15½ feet. Between the years 1852 and 1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top.

The depth of water immediately inside the breakwater being insufficient for many vessels that seek the harbor for refuge, the present project for the improvement of the harbor contemplates dredging the area protected by the breakwater to a depth of 15½ feet at mean low water.

The amount expended on this work up to June 30, 1890, was $141,441.58.

The breakwater had been completed according to the original project and subsequent plans for strengthening it, and the 15½-foot anchorage area had been increased by about 7 acres.

At the beginning of the last fiscal year work was in progress, and was continued until July 11, 1890. On account of the exposed condition of the dumping ground it has not been the practice to attempt any work of dredging in this harbor, except during the summer season. Work was resumed May 19, 1891, and is now in progress with plant owned by the Government and a hired tug.

About 4 acres have been dredged in the 15½-foot anchorage area protected by the breakwater.

The balance on hand and the amount asked for, $17,662, will be applied to dredging in the area protected by the breakwater.

July 1, 1890, balance unexpended	$3,521.95
Amount appropriated by act approved September 19, 1890	8,000.00
	11,521.95
June 30, 1891, amount expended during fiscal year	6.269.92
July 1, 1891, balance unexpended	5,252.03
July 1, 1891, outstanding liabilities	3,237.03
July 1, 1891, balance available	2,015.00
Amount (estimated) required for completion of existing project	17,662.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	17,662.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix C 1.)

2. *Harbor of refuge at Nantucket, Massachusetts.*—This harbor is the only one between the harbors of Martha's Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the north side of Nantucket Sound. It has deep water inside, and the object of improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod.

Before the commencement of the present work there was a shoal about 1½ miles in width outside the entrance, through which the channel or line of best water was only about 6 feet deep, and very crooked and subject to changes in location.

The present approved project is to construct jetties of riprap stone, projecting from either side of the present entrance to the harbor, for the purpose of concentrating the strength of the tidal currents and excavating a channel of 15 feet depth by scour, and at the places where the full depth required will not be reached by this means to complete the work by dredging.

The amount expended on this project up to the close of the fiscal year ending June 30, 1890, was $144,951.30, and the result was the construction of the west jetty to a point 3,955 feet from the shore, and the east jetty to a distance of 834 feet from its initial point on shore, which is the outer end of the middle of the three northwest spurs built on Coatue Beach some years ago, and the foundation was laid and the jetty partially completed for an additional distance of 191 feet.

Preparations have been made for carrying on the work by hired labor. The construction of the east jetty was resumed June 26.

The balance available and the amount asked for, $100,000, is to be applied to the further extension of the east jetty, and raising low places in the west jetty, together with a little dredging, if necessary.

July 1, 1890, balance unexpended	$531.81
Amount appropriated by act approved September 19, 1890	25,000.00
	25,531.81
June 30, 1891, amount expended during fiscal year	8,303.59
July 1, 1891, balance unexpended	17,228.22
July 1, 1891, outstanding liabilities	2,613.22
July 1, 1891, balance available	14,615.00
Amount (estimated) required for completion of existing project	205,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 2.)

3. *Martha's Vineyard Inner Harbor at Edgartown, Masssachusetts.*—The inner harbor at Edgartown lies in the northern part of the waterway or strait that separates Chappaquiddick Island from the east end of Martha's Vineyard. It extends southward about 1½ miles from Chappaquiddick Point opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor of refuge for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents make it difficult to pass through.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $2,000 for dredging in the harbor.

A shoal known as the Middle Ground lies in the central portion of the harbor. It is proposed to excavate this shoal to a depth of 10 feet at mean low water.

The project provides for the commencement of dredging on the western side of the shoal, carrying the work as far to the eastward as funds will permit.

Preparations have been made for carrying on the work by hired labor.

It is proposed to apply the balance of the funds on hand and the amount asked for, $2,500, to the completion of the project.

Amount appropriated by act approved September 19, 1890	$2,000.00
June 30, 1891, amount expended during fiscal year	13.25
July 1, 1891, balance unexpended	1,986.75
July 1, 1891, outstanding liabilities	232.75
July 1, 1891, balance available	1,754.00
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 3.)

4. *Harbor at Vineyard Haven, Massachusetts.*—The plan of improvement contemplates the protection of the points of land at the entrance to the harbor known as East Chop and West Chop by the construction of jetties and other works along the shore to stop the wearing away of the chops by the action of the storm waves.

The amount expended on this project up to the close of the fiscal year ending June 30, 1890, including outstanding liabilities, was $23,339, and the result was the construction of a wharf and three jetties at West Chop.

During the last fiscal year a jetty was commenced on the East Chop, jetty No. 1 on the West Chop was extended 150 feet, and a longitudinal wall on the West Chop was built for a distance of 80 feet.

The balance available and the amount asked for, $25,000, will be applied to continuing the work of protection, mainly at the East Chop.

July 1, 1890, balance unexpended	$5,359.05
Received by Treasury settlement	2.74
Amount appropriated by act approved September 19, 1890	10,000.00
	15,361.79
June 30, 1891, amount expended during fiscal year	8,268.65
July 1, 1891, balance unexpended	7,093.14
July 1, 1891, outstanding liabilities	1,017.14
July 1, 1891, balance available	6,076.00
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 4.)

5. *Wareham Harbor, Massachusetts.*—The object of the improvement is to deepen and widen the channel leading from Buzzards Bay to Wareham. The commerce of Wareham is carried on in sailing vessels, and the channel is to be made a beating channel for such vessels. Another object of the improvement is the raising of Long Beach.

Before improvement the ruling depth in the harbor was about 7 feet at mean low water in a narrow and very crooked channel. Long Beach, a narrow sand spit at the mouth of the harbor, was washed and abraded by the waves and currents at high water, and the material was carried into and shoaled the channel inside.

The original approved project of 1871 for the improvement, and its subsequent modifications, provides for a channel 250 feet wide and 10 feet deep at mean low water from Barney Point down to the entrance to the harbor. Above Barney Point the width of the channel is to be 350 feet, with the same depth—10 feet—as below that point. The plan includes also the raising and strengthening of Long Beach, of

which a large portion was submerged at low water, to carry it above the storm waves and currents and to hold it there, in order to prevent the filling of the improved channel above, by material abraded from the beach.

The total amount expended on the improvement up to the close of the fiscal year ending June 30, 1890, including outstanding liabilities at that date, was $83,968.63, and the result was that the channel in the upper part of the harbor in front of the wharves was carried to its full width and completed, and the eastern half of the second and third reaches below the wharves, and about two-thirds of the eastern half of the fourth reach, which extends to Barney Point, were deepened to 10 feet at mean low water. The channel for about one-half its width from Barney Point to Wareham has been deepened to 10 feet, and a portion of Reach No. 9, formerly obstructed by the shoal known as the Middle Ground, had been deepened to 10 feet. Long Beach has been raised above high-water storm tides, so that the wash of sand into the improved channel inside the beach has been stopped.

The ruling depth of the approaches to Wareham has been increased from 7 to 9 feet, and the channel greatly widened in all the reaches. Vessels of larger draft can be carried to Wareham than formerly. The increase in width of channel is a great help to all vessels in beating in and out of the harbor.

A contract has been made for dredging under the appropriation made by the act of September 19, 1890. The time for commencement of work under this contract has been extended to August 15, 1891.

The balance available and the amount asked for, $7,236, will be applied to continuing the work of dredging and to the building up of Long Beach if necessary.

July 1, 1890, balance unexpended	$145.39
Received by Treasury settlement	12.42
Amount appropriated by act approved September 19, 1890	5,000.00
	5,157.81
June 30, 1891, amount expended during fiscal year	903.88
July 1, 1891, balance unexpended	4,253.93
July 1, 1891, amount covered by uncompleted contracts	1,760.00
July 1, 1891, balance available	2,493.93
Amount (estimated) required for completion of existing project	7,236.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,236.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 5.)

6. *New Bedford Harbor, Massachusetts.*—Before improvement the channel had a depth of about 12½ feet at mean low water. The original project for its improvement as modified in 1877 provided for a channel 300 feet wide and 15 feet deep at mean low water from the deep water just above Palmer Island to the wharves at New Bedford. This project was completed in 1877 at a cost of $20,000.

The object of the present improvement is to provide a channel 200 feet wide and 18 feet deep at mean low water.

The amount expended to June 30, 1890, including outstanding liabilities at that date, was $29,966.02. The result was the excavation of the channel, under the original project and its modifications, to a width of 300 feet and a depth of 15 feet at mean low water, and the excavation

of a channel 100 feet wide and 18 feet deep from the 11-foot bank to the vicinity of the wharves of New Bedford.

Preparations have been made to do the work by hired labor.

The work required to complete the existing project is the excavation of the remaining half of the channel 200 feet wide and 18 feet deep, extending from the "11-foot bank" to the vicinity of the wharves at New Bedford, and the removal of a few shoal spots between the "11-foot bank" and Butler's Flats, the southern end of the projected channel.

The balance available and the amount asked for, $15,000, will be applied to the continuation of this project.

July 1, 1890, balance unexpended	$57.65
Received by Treasury settlement	12.03
Amount appropriated by act approved September 19, 1890	10,000.09
	10,070.22
June 30, 1891, amount expended during fiscal year	3,038.55
July 1, 1891, balance unexpended	7,031.67
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 6.)

7. *Westport Harbor, Massachusetts.*—Westport Harbor is an estuary on the coast of Massachusetts, lying between Narragansett Bay, Rhode Island, and Buzzard Bay, Massachusetts. The site of the work is on Horse Neck Point (the north side of the entrance to the harbor).

Before the commencement of the improvement the site of the present work was a point of sand forming the northern and eastern boundary of the entrance to the harbor, and subject to erosion by the sea and tides.

The original project of 1887, with its subsequent modifications, provides for the construction of jetties at the end of Horse Neck Point to stop the wearing of this point.

The amount expended to June 30, 1890, was $1,000, and the result was the construction of one jetty on Horse Neck Point.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $1,000 for the continuation of the improvement. A project for the expenditure of this sum was prepared, and was approved by the Chief of Engineers. This project provides for extending the present jetty to a point near the low-water line, and a small amount of dredging on the Lion's Tongue Shoal, near the mouth of the west branch of the river.

Preparations have been made for carrying on the work by hired labor.

The work required to complete the existing project is the extension of the present jetty and the dredging on the Lion's Tongue Shoal.

The balance on hand and the amount asked for ($1,977.04), will be applied to the completion of the existing project.

Amount appropriated by act approved September 19, 1890	$1,000.00
June 30, 1891, amount expended during fiscal year	22.96
July 1, 1891, balance unexpended	977.04
Amount (estimated) required for completion of existing project	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 7.)

8. *Taunton River, Massachusetts.*—The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, so that vessels of 11 feet draft can reach the city at high water.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

The approved project of 1871 and its subsequent modifications provide for a channel 60 feet wide and 11 feet deep from Weir Bridge to the ship-yard, a channel 80 feet wide (100 feet at the bends) and 11 feet deep from the ship-yard down to and through the Needles and Briggs Shoal; thence to Berkley Bridge a channel of the same width and 12 feet deep, and from Berkley Bridge to the deep water at Dighton the channel was to be 100 feet wide and 12 feet deep. The depths are estimated from high water. The ledge which crossed the bottom of the river at Peter Point and the numerous bowlders which lay on the bottom and sides of the channel from Taunton to Dighton were to be removed. The amount expended on the improvement of the river up to the close of the fiscal year ending June 30, 1890, was $156,987.22.

With the exception that but 40 feet of the 60 feet of width could be dredged between the bridge at Weir and the ship-yard, on account of interfering with private property and that on account of the hardness and depth of material at the sides the 80-foot channel was not in all cases dredged to its full width, the channel down to Berkley Bridge had been completed. The channel as proposed between Berkley Bridge and Dighton had been completed, with the exception of removing a small amount of ledge rock uncovered in dredging below Peter Point, and had been cleared of bowlders from Taunton down to Berkley Bridge. The work of removal of the ledge at Peter Point had been completed. The material blasted in the channel had been dredged and deposited in the form of a half-tide dam running from Reuben Island to the west shore of the river, with the view of accelerating the current in the dredged channel off and above Dighton and preventing deposits in this part of the channel. Vessels of 11 feet draft can now reach Taunton, at the head of navigation.

The work of dredging was commenced June 18, 1891, with plant belonging to the Government and a hired tug and was in progress at the end of the fiscal year. The dredging was commenced at the first shoal above Berkley Bridge and continued up stream. The first reach and a portion of the second were completed.

There remain, to complete the existing project, widening and deepening at a few points above the bridge and the removal of the small amount of ledge rock above referred to. A map of a survey of parts of Taunton River, with report thereon, and project for further improvement, were submitted to Congress January 10, 1888, and printed as House Ex. Doc. No. 86, Fiftieth Congress, first session.

The balance available and the amount asked for, $7,000, is to be applied to continuing the improvement.

July 1, 1890, balance unexpended	$27.78
Amount appropriated by act approved September 19, 1890	7,000.00
	7,027 78
June 30, 1891, amount expended during fiscal year	2,682.09
July 1, 1891, balance unexpended	4,345.69
July 1, 1891, outstanding liabilities	1,597.19
July 1, 1891, balance available	2,748.50

Amount (estimated) required for completion of existing project	$7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 8.)

9. *Pawtucket River, Rhode Island.*—Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

The project for its improvement, as modified in 1883, provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Company's wharf at Pawtucket; thence the deepening by blasting of a channel through the ledge to Pawtucket Bridge, of the same depth and 40 feet wide.

The amount expended to June 30, 1890, was $167,005.96. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in 1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends from the deep water above Red Bridge to within 1¼ miles of the head of navigation, and 60 feet wide and of the same depth to within three-fourths of a mile of the same point, had been completed.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

Preparations were made for carrying on the work by hired labor. Two Government dredges and five scows will soon be ready for this work.

The work yet to be done is to excavate the channel to its full width of 100 feet from Bass Rock to a point opposite Grant & Company's wharf, and thence to Pawtucket Bridge, to deepen the channel through the ledge to the same depth with a width of 40 feet.

It is proposed to extend the channel towards Pawtucket by dredging and to commence work on the ledge.

The balance available and the amount asked for, $100,000, will be applied to continuing the improvement.

July 1, 1890, balance unexpended	$656.05
Received by Treasury settlement	19.95
Amount appropriated by act approved September 19, 1890	30,000.00
	30,676.00
June 30, 1891, amount expended during fiscal year	12,128.02
July 1, 1891, balance unexpended	18,547.98
July 1, 1891, outstanding liabilities	307.48
July 1, 1891, balance available	18,240.50

Amount (estimated) required for completion of existing project	337,478.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 9.)

10. *Providence River and Narragansett Bay, Rhode Island.*—The object of this improvement is to furnish a wide and deep channel for foreign and coastwise commerce from the ocean to Providence.

Before the improvement of the river was commenced in 1853 many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel, first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which the work is now in progress, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Field Points, 300 feet wide, at a depth of 25 feet; 600 feet wide, at a depth of 20 feet; 725 feet wide, at a depth of 18 feet; 940 feet wide, at a depth of 12 feet; 1,060 feet wide, at a depth of 6 feet.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $283,600.63. At that date the 25-foot channel 300 feet wide had been completed. Bulkhead Rock had been removed. The excavation of the 20-foot anchorage area had been completed in Fox Point Reach, and of the same areas in the Sassafras Point and the Field Point Reaches about three-fourths and one-half respectively had been done, and the 18-foot area on the east side of the Fox Point Reach and about three-fourths of the 18-foot area on the same side of Sassafras Point Reach were finished.

A contract was made for the work under the appropriation of September 19, 1890, and the work commenced April 28, 1891, and was in progress at the close of the fiscal year.

The 18, 12, and 6 foot areas on the west side of Fox Point Reach have been completed, and the 12-foot area on the east side of the same reach was commenced. The capacity of the Government plant has been increased by the construction of large scows.

There is required for the completion of the existing project the excavation of the remainder of the anchorage basin between Fox and Field Points.

The balance available and the amount asked for, $115,000, will be applied to the continuation of the work according to the project.

July 1, 1890, balance unexpended		$887.56
Amount appropriated by act approved September 19, 1890		50,000.00
		50,887.56
June 30, 1891, amount expended during fiscal year		24,678.39
July 1, 1891, balance unexpended		26,209.17
July 1, 1891, outstanding liabilities	$10,399.74	
July 1, 1891, amount covered by uncompleted contracts	10,739.43	
		21,139.17
July 1, 1891, balance available		5,070.00
Amount (estimated) required for completion of existing project		115,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		115,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix C 10.)

11. *Removal of Green Jacket Shoal, Providence River, Rhode Island.*—This shoal is in that part of Providence River which constitutes the harbor of Providence. It lies off the wharves, on the south front of the city, and occupies a part of the harbor that is required for anchorage purposes, covering an area of about 18 acres between the 15-foot curves.

The adopted project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

The amount expended, including outstanding liabilities to June 30, 1890, was $54,250, and the result was the excavation of an area of about 13¾ acres on the western side of the shoal to a depth of 25 feet at mean low water, making an important addition to the anchorage facilities of Providence Harbor.

At the beginning of the last fiscal year no work was in progress.

A contract was made for the work under the appropriation of September 19, 1890, and the dredging will commence as soon as that at Providence River is completed. The capacity of the government plant has been increased by the construction of large dump scows

The balance available with the amount asked for, $33,096, will be applied to the continuation of the excavation of the shoal.

July 1, 1890, balance unexpended		$23.50
Received by Treasury settlement		10.07
Amount appropriated by act approved September 19, 1890		25,000.00
		25,033.57
June 30, 1891, amount expended during fiscal year		10,780.13
July 1, 1891, balance unexpended		14,253.44
July 1, 1891, outstanding liabilities	$332.44	
July 1, 1891, amount covered by uncompleted contracts	11,700.00	
		12,032.44
July 1, 1891, balance available		2,221.00

Amount (estimated) required for completion of existing project	33,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	33,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 11.)

12. *Greenwich Bay, Rhode Island.*—Greenwich Bay is an arm of Narragansett Bay, located in the towns of Warwick and East Greenwich, R. I. It has a length from northwest to southeast of about 3½ miles and an average width of 1½ miles.

The channel leading to the town of East Greenwich was deep enough for the present demands of commerce, but so crooked as to render navigation difficult.

This is a new work, and no appropriation had been made for it, until, by act of September 19, 1890, Congress appropriated $2,000 for widening the channel.

The improvement contemplated was the straightening and widening of the channel by the removal of sand-bars and shoals.

The project provided for dredging to a depth of 10 feet on the western edge of the bar extending out from Long Point, carrying the work to the eastward as far as the funds would permit.

The project has been completed by cutting off the bar extending out from Long Point about 210 feet; the channel has been widened for a distance of about 500 feet.

Amount appropriated by act approved September 19, 1890	$2,000.00
June 30, 1891, amount expended during fiscal year	1,896.08
July 1, 1891, balance unexpended	103.92
July 1, 1891, outstanding liabilities	92.92
July 1, 1891, balance available	11.00

(See Appendix C 12.)

13. *Cove and water-way near Coaster Harbor Island, Rhode Island.*—This cove is situated in the northwestern part of the city of Newport, R. I., near the southeastern extremity of Coaster Harbor Island, which is occupied by the U. S. Navy as a training station. A causeway connecting Coaster Harbor Island with Rhode Island forms the northern boundary of the cove and separates it from the water-way above. This causeway having but one small opening has checked the flow of water around the island and caused deposits, so filling the water-way as to cause it to give forth unhealthy and disagreeable odors.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $5,500 for improving the cove and water-way.

The projected improvement is to dredge the cove to the necessary depth and to increase the flow of water by larger openings in the causeway.

Work was commenced February 6, 1891, and the dredging contemplated in the project was completed April 1, 1891.

The bridges are framed and ready to put in position in a short time.

To complete the existing project it is only necessary to cut the causeway and erect the bridges.

Amount appropriated by act approved September 19, 1890	$5,500.00
June 30, 1891, amount expended during fiscal year	2,266.97
July 1, 1891, balance unexpended	3,233.03
July 1, 1891, outstanding liabilities	138.03
July 1, 1891, balance available	3,095.00

(See Appendix C 13.)

14. *Newport Harbor, Rhode Island.*—Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of the vessels seeking it for refuge. The southern or main entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

The original project and its subsequent modification, under which work is now carried on, are substantially as follows:

Deepening the south entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit, to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; deepening to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the east, and a line drawn parallel to and 50 feet from the city wharf on the north; deepening to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle which is in the southeast part of the harbor, and excavating a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf; and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the entrance of the harbor.

The amount expended up to the close of the fiscal year ending June 30, 1890, was $120,202.03, with the following results:

The 13-foot anchorage area had been completed. The channel along and outside the harbor line south to a point opposite the gas com-

pany's wharf and the 15-foot channel, 750 feet wide, around and to the eastward of the dolphin on Goat Island Spit, had been completed, with the exception of a narrow strip along the western edge and to the north of the dolphin. The increase of width to be made between the 15-foot curves at the southern entrance by dredging in the spit south of Goat Island had been completed. The berth for vessels at the quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draught, and of the total area to be dredged within the harbor (about 90 acres) about two-thirds had been completed.

At the beginning of the last fiscal year no work was in progress. Work was commenced February 7, 1891, and completed April 18, 1891.

The expenditures during the year resulted in the dredging of the strip along the western edge of the 15-foot channel north of the dolphin, and 6 acres of the 10-foot anchorage area.

The work required to complete the existing project is the dredging of the remainder of the narrow strip along the western edge of the 15-foot channel north of the dolphin and the excavation of the 10-foot anchorage area; also the building of additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

The balance available and the amount asked for, $27,500, are to be applied to continuing the improvement.

July 1, 1890, balance unexpended	$11.68
Received by Treasury settlement	5.09
Amount appropriated by act approved September 19, 1890	12,500.00
	12,516.77
June 30, 1891, amount expended during fiscal year	11,200.89
July 1, 1891, balance unexpended	1,315.88
July 1, 1891, outstanding liabilities	1,295.88
July 1, 1891, balance available	20.00
Amount (estimated) required for completion of existing project	27,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	27,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 14.)

15. *Harbor of refuge at Point Judith, Rhode Island.*—Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction about 1½ miles west of the Point.

The object of the improvement is to afford a harbor of refuge for passing vessels.

The plan of improvement contemplates the construction of riprap breakwaters on Squid Ledge and between the southern extremity of this ledge and Point Judith. This is a new work.

By act of September 19, 1890, Congress appropriated $75,000 for the work.

Preparations have been made for carrying on the work by hired labor.

A beacon has been established on the outer end of Squid Ledge, and

the construction of the two arms extending one to the north and the other to the east of this point commenced.

It is proposed to apply the balance available and the appropriation asked for, $300,000, to continuing the construction of the breakwater.

Amount appropriated by act approved September 19, 1890	$75,000.00
June 30, 1891, amount expended during fiscal year	24,671.15
July 1, 1891, balance unexpended	50,328.85
July 1, 1891, outstanding liabilities	6,028.85
July 1, 1891, balance available	44,300.00
Amount (estimated) required for completion of existing project	1,175,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	300,000.00

Submitted in compliance with the requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix C 15.)

16. *Harbor of refuge at Block Island, Rhode Island.*—The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce.

Before the construction of the present harbor Block Island had no harbor which afforded protection for decked vessels. The original project and its subsequent modifications provide for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior for large ones. The basin was to be about 250 feet by 300 feet in area and inclosed, with the exception of an opening 80 feet wide. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,900 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the enlargement of the inner harbor.

The total expenditures to June 30, 1890, were $354,125.59.

The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor, and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor, especially, was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor, and a masonry wall constructed on the inside of the crib work forming the eastern side of the inner harbor. The filling of the gap in the main breakwater had been completed.

The timber jetty, filled with stone, forming the shore end of the western wall of the enlarged inner harbor and about 160 feet of its north wall had been finished, and about 140 feet of the wall west of the opening into the harbor had been built to the level of mean high water.

The shoal west of the breakwater had been dredged to a depth of 9 feet, from the steamboat wharf to within 100 feet of the north wall.

By act of September 19, 1890, Congress appropriated $15,000 for continuing the work.

The work was carried on by hired labor. The north wall was extended to the westward, the foundation reaching to within 50 feet of the end.

The balance on hand and the amount asked for, $24,000, will be applied to the continuation of the work under the existing project.

July 1, 1890, balance unexpended	$2,171.48
Amount appropriated by act approved September 19, 1890	15,000.00
	17,171.48
June 30, 1891, amount expended during fiscal year	7,726.45
July 1, 1891, balance unexpended	9,445.03
July 1, 1891, outstanding liabilities	4,861.03
July 1, 1891, balance available	4,584.00
Amount (estimated) required for completion of existing project	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	24,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix C 16.)

17. *Pawcatuck River, Rhode Island and Connecticut.*—The navigable part of the Pawcatuck River extends from the town of Westerly to Little Narragansett Bay, and the object of the improvement is to deepen and widen this channel.

Before improvement, the channel was crooked and obstructed by numerous shoals, on some of which there was but $1\frac{1}{4}$ feet of water at mean low water.

By appropriations made in the years 1871 to 1875 the river was improved by the excavation of a channel $5\frac{1}{2}$ feet deep at mean low water and 75 feet wide below the wharves and from 35 to 40 feet wide between the upper and lower wharves. The present project contemplates the further widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging machine, or about 40 feet, between the lower and upper wharves; also the deepening of the entire channel to 8 feet at mean low water.

The amount expended on the present project to June 30, 1890, including outstanding liabilities, was $20,862.62, and the result was the completion of the channel from the deep water opposite the village of Lottery to a point near the upper end of Major's Island.

At the beginning of the last fiscal year no work was in progress. Operations were resumed April 28, 1891, and were in progress at the close of the fiscal year.

The channel has been extended to a point about 1,000 feet above Major's Island.

The balance available, $3,885, will be applied to the extension of the channel according to the project.

July 1, 1890, balance unexpended		$482.04
Received by Treasury settlement		13.08
Amount appropriated by act approved September 19, 1890		16,600.00
		17,095.12
June 30, 1891, amount expended during fiscal year		6,260.43
July 1, 1891, balance unexpended		10,834.69
July 1, 1891, outstanding liabilities	$3,286.05	
July 1, 1891, amount covered by uncompleted contracts	3,663.64	
		6,949.69
July 1, 1891, balance available		3,885.00

(See Appendix C 17.)

18. *Harbor of refuge at Stonington, Connecticut.*—Stonington Harbor originally was an open bay, unprotected from southerly storms and obstructed by a shoal having a low-water depth of but 6 feet at the shoalest part. A short breakwater was constructed in the years 1828–'31, at

a cost of $34,766.65, for the protection of the commerce of the town. The enlarged project of 1871 for the improvement of the harbor, and its subsequent modification, under which work is now carried on, embraced dredging in the upper harbor and the construction of two breakwaters in the outer harbor. One of these, the western, was to be built out from Wamphassuck Point, the southwestern limit of the harbor, and to extend about 2,000 feet; and the other, the eastern, was to extend from the vicinity of Bartlett Reef to the Middle Ground. The western breakwater was completed in 1880, at a cost of $103,190. The amount expended in dredging in the upper harbor was about 45,000. The position of the western end of the eastern breakwater has not been determined.

The amount expended on the eastern breakwater up to the close of the fiscal year ending June 30, 1890, was $115,852.23, and its length at that date was 2,290 feet.

By act of September 19, 1890, Congress appropriated $12,500 for the continuation of the work.

Work was commenced December 10, 1890, by hired labor, and was in progress at the close of the fiscal year.

The eastern breakwater was extended 87 feet to a point about 2,377 feet from its eastern extremity.

The balance on hand and the amount asked for, $12,500, will be expended in extending the eastern breakwater farther to the westward.

July 1, 1890, balance unexpended	137.69
Received by Treasury settlement	24.89
Amount appropriated by act approved September 19, 1890	12,500.00
	12,662.58
June 30, 1891, amount expended during fiscal year	9,462.38
July 1, 1891, balance unexpended	3,200.20
July 1, 1891, outstanding liabilities	2,710.20
July 1, 1891, balance available	490.00
Amount (estimated) required for completion of existing project	12,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix C 18.)

19. *Removing sunken vessels or craft obstructing or endangering navigation.—Wreck of schooner Benjamin Gartside.*—This vessel was sunk by collision October 5, 1889, while lying at anchor about 2½ miles from Handkerchief light-ship. She was loaded with a cargo of coal. A contract for removal of the wreck was made, and work was commenced June 18, 1890, and completed September 15, 1890.

The property recovered was sold at public auction and the proceeds covered into the Treasury.

Wreck of schooner Weybosset in the channel through Pollock Rip Shoals, Massachusetts.—This vessel struck on the shoals and sank August 13, 1890, near the bell buoy north of Pollock Rip light-ship. She was loaded with paving stone. A contract for the removal of the wreck was made and entered into, and the work was completed June 6, 1891.

Wreck of schooner Josiah Whitehouse.—This vessel was sunk by collision October 12, 1890, about 3¾ miles from Gay Head Light. She was loaded with a cargo of coal. A contract for the removal of the wreck was made and entered into, and the work was completed December 31, 1890.

Wreck of schooner S. S. Bickmore.—This vessel caught fire and sank in Hyannis Harbor October 20, 1890. She was loaded with a cargo of lime. A contract for removal of the wreck was made and entered into, and the work was completed June 6, 1891.

(See Appendix C 19.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Livermore, and reports thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Major Livermore, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Narragansett Bay Channel, Rhode Island, between Starve Goat Island and the mainland, with a view of deepening the same.*—Printed as House Ex. Doc. No. 173. (See also Appendix C 20.)

2. *Watch Hill Cove, Rhode Island, in Little Narragansett Bay.*—Printed as House Ex. Doc. No. 174. (See also Appendix C 21.)

The required preliminary examination of *Newport Harbor, Rhode Island, South of Goat Island, with a view to the removal of the Spit at the south end of the Island*, was made by the local engineer in charge, Major Livermore, and report thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Major Livermore and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The proposed improvement contemplates the removal of the shoal at the south end of Goat Island to a depth of 15 feet at mean low water, the cost of which is estimated at $24,200. The report was transmitted to Congress and printed as House Ex. Doc. No. 180, Fifty-first Congress, second session. (See also Appendix C 22.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Livermore, and reports thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Major Livermore, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Major Livermore was charged with their survey, the reports of which will be submitted when received.

1. *Menemsha Bite [Bight], Massachusetts, an outlet into Vineyard Sound, on the north shore of the island of Martha's Vineyard, with a view of preventing the closing of said inlet.*

2. *Canapitsit channel, Massachusetts, between the island of Cuttyhunk and Neshawana, with a view of deepening the same and clearing the channel from obstructions to navigation.*

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT, AND OF RIVERS AND HARBORS ON LONG ISLAND SOUND, CONNECTICUT AND NEW YORK, AND ON SOUTHERN SHORE OF LONG ISLAND, NEW YORK.

Officer in charge, Col. D. C. Houston, Corps of Engineers.

1. *Mystic River, Connecticut.*—This is a tidal river about 4 miles in length, extending northward from Fishers Island Sound; its natural depth for the lower 2 miles was 15 feet or more at low tide in a very crooked and narrow channel; thence for a mile further, to the village of Mystic, the depth shoaled to about 9 feet. Above Mystic there has been little navigation.

In 1888 an examination of the river was made, and subsequently a project was adopted for dredging to carry the depth of 15 feet at mean low water with width of 100 feet up to the highway bridge and to widen five bends in the stream, at an estimated cost of $30,000.

Work under this project was begun during the past fiscal year and $1,644.33 have been expended in dredging to deepen the channel near Mystic, under a contract not yet completed.

The total amount appropriated for this improvement is $10,000.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		1,644.33
July 1, 1891, balance unexpended		8,355.67
July 1, 1891, outstanding liabilities	$159.06	
July 1, 1891, amount covered by uncompleted contracts	5,759.31	
		5,918.37
July 1, 1891, balance available		2,437.30
Amount (estimated) required for completion of existing project		20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D 1.)

2. *Thames River, Connecticut.*—This river is a tidal stream, extending from the city of Norwich 15 miles south to Long Island Sound. For 11 miles above its mouth the depth ranges from 13 to 80 feet. Until 1889 improvements were confined to a stretch of 3½ miles below Norwich, in which the most troublesome bars lay. In 1829 the channel depth over these bars was about 6 feet at mean low water.

In 1836 a project was adopted for making the channel 100 feet wide and 14 feet deep at mean high water (11 feet at low water) by dredging and building piers. In 1878 a channel 14 feet deep at low water was projected, and in 1882 a modification was adopted providing for a channel 200 feet wide and 14 feet deep at mean low water, to be obtained by dredging and by building five dikes or training walls along the outer sides of the channel curves. The estimated cost was $208,080; and a balance of $20,000 from previous appropriations was then available. In 1888 the project was extended to include making 16 feet depth as far up as Allyn Point and 14 feet from there to Easter Point, at an additional cost of $40,000.

Three of the proposed dikes have been completed and the fourth one nearly so. Dredging was done between the dikes in 1882, 1883, 1884, 1887, 1888, and 1889. The channel has an available depth from Norwich to Easter Point (3½ miles) of nearly 12 feet; from Easter Point to Allyn Point of 14 feet, and below Allyn Point 16 feet.

During the past fiscal year $8,535.86 have been expended; one of

the old piers, which projected into the channel, has been removed, and dredging in the river about a mile below Norwich has been done under a contract still in progress.

July 1, 1890, balance unexpended		$17,437.64
Amount appropriated by act approved September 19, 1890		20,000.00
		37,437.64
June 30, 1891, amount expended during fiscal year		8,535.86
July 1, 1891, balance unexpended		28,901.78
July 1, 1891, outstanding liabilities	$5,678.52	
July 1, 1891, amount covered by uncompleted contracts	17,692.57	
		23,371.09
July 1, 1891, balance available		5,530.69
Amount (estimated) required for completion of existing project		75,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		75,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D 2.)

3. *New London Harbor, Connecticut.*—This harbor includes the lower 3 miles of Thames River, from New London to Long Island Sound.

The project for improvement, adopted in 1880 and slightly modified in 1882, provided for removing to a depth of 16 feet at mean low water the southerly part of a shoal of sand and boulders lying east of the New London Northern Railroad wharf. The original depth on this part of the shoal was from 5 to 15 feet.

Nineteen thousand eight hundred dollars have been appropriated for and expended on this work.

Nothing was done during the past fiscal year.

The required depth has been made over nearly the whole area contemplated in the project, which is regarded as completed, no further work under it being desired.

(See Appendix D 3.)

4. *Connecticut River, Massachusetts and Connecticut—above Hartford.*—From Holyoke, Mass., 34 miles above Hartford, down to Enfield Falls or rapids, a distance of 18 miles, there is a fair channel 4 to 5 feet deep. Enfield Rapids extends about 5 miles over a rocky and uneven bed, with a total fall of 32 feet. From the foot of Enfield Rapids to Hartford, a distance of 11 miles, the river bed is broad and sandy, with a channel from 2 to 5 feet deep at low water. Several years ago the Connecticut River Company constructed a small canal around Enfield Rapids, through which boats of 3 feet draft and 80 feet length can pass.

The several projects under which work has been done have been for dredging at Barber Landing and for wing dams. In 1878 plans and estimates were submitted for construction of a canal 8 feet deep around Enfield Rapids. These estimates were revised in 1880. The estimated cost of the canal was $1,322,805. It was not considered advisable to commence construction with a less sum than $450,000, which has not yet been appropriated.

Up to the close of the present fiscal year $100,000 has been appropriated for this part of the river, of which $91,059.70 has been expended.

All the work done has been dredging and the construction and repair of seven wing dams.

No work was done during the past fiscal year.

The funds on hand from previous appropriations are sufficient for such repairs and temporary improvement as may be needed during the ensuing fiscal year.

July 1, 1890, balance unexpended	$8,940.30
July 1, 1891, balance unexpended	8,940.30

Connecticut River, below Hartford.—Between Hartford and Long Island Sound, a distance of 50 miles by course of channel, the depth on the bars was formerly 5 feet at low water, the worst places being between Hartford and Middletown, a distance of 19 miles, and at Saybrook Bar, at the mouth of the river. Dredging was carried on and small wing dams were constructed by private parties and by a State corporation up to 1868 with no permanent benefit.

In 1868 a project for improvement by the United States was submitted, under which a pile-dike was built at Hartford, and annual dredging done on the bars below Hartford until 1883. In 1873 a project for the construction of three jetties on Saybrook Bar was adopted; two of these have been built, the third will probably not be required. In 1880 a project for permanent improvement of six of the worst bars between Hartford and Middletown was adopted; it contemplated building riprap wing dams, rectifying the banks, and protecting the caving banks by mattresses, at a total estimated cost of $330,487. It was afterwards found necessary to extend the project to include annual dredging at these and other bars, and the extension, and repair of the Saybrook jetties. Two of the contemplated works have been built, a training wall at Hartford Bar and a wing dam at Glastonbury Bar, their total cost being $40,715.34. In addition to the work included in the estimate of $330,487, the east and west jetties at Saybrook have been extended and repaired, and a channel 130 feet wide and 12 feet deep has been dredged between them, and from $5,000 to $10,000 have been annually expended in dredging to maintain a depth of 9 feet on the bars between Hartford and Saybrook.

Experience has shown that on account of the frequency and height of freshets in this river, the permanent works projected in 1880 would be inadequate to maintain the desired depth, or even to materially reduce the amount of dredging annually required. Therefore, in December, 1887, a new project was adopted, confining future operations to the completion of the Saybrook jetties to a height of 5 feet above high water, with a top width of 6 feet, and widening the channel between the jetties to 400 feet, with a depth of 12 feet at mean low water, at an estimated cost of $80,000, with annual dredging to maintain a 9-foot channel between Hartford and Long Island Sound, at an average cost of $10,000 per year.

In 1890, an extension of the project was adopted to provide for raising the Hartford Dike to about 15 feet above low-water level, at an additional estimated cost of $50,000.

It is believed that the effect of raising the dike will be to considerably reduce the cost of annual maintenance by dredging, and cause less interference with navigation by the occupation of the low water channel by the dredging plant. Moreover, the revised estimate of $80,000, submitted for completion in 1888, was a reduction in the estimate for works previously proposed of about $290,000.

During the past fiscal year dredging has been done to maintain the navigable channels of 9 feet depth, under a contract now in progress.

Future appropriations will be applied to maintenance of such a channel, to raising the Hartford Dike and completing the Saybrook jetties, and to widening the channel through Saybrook Bar.

The appropriation of 1890, $12,500, being applied to annual maintenance of channel, does not reduce the estimate of amount required for completion, which is, as before that appropriation, $130,000.

July 1, 1890, balance unexpended		$516.42
Amount appropriated by act approved September 19, 1890		12,500.00
		13,016.42
June 30, 1891, amount expended during fiscal year		1,741.75
July 1, 1891, balance unexpended		11,274.67
July 1, 1891, outstanding liabilities	$3,753.30	
July 1, 1891, amount covered by uncompleted contracts	6,787.45	
		10,540.75
July 1, 1891, balance available		733.92
Amount (estimated) required for completion of existing project		130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		90,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix D 4.)

5. *Duck Island Harbor, Connecticut.*—This harbor is a broad bay on the north side of Long Island Sound, about midway between the harbors of New Haven and New London, a distance of 46 miles in the widest part of the sound where there is no sufficient harbor or refuge for general commerce. Duck Island Harbor is large enough for such use, but is naturally unprotected from storms from any southerly quarter.

By order of Congress examinations of this harbor were made in 1883 and 1886, and subsequently a project was adopted for making it a harbor of refuge by constructing three breakwaters, west one extending westerly from Duck Island, the middle one extending northeasterly from Duck Island, and the east one extending southwesterly from Menunketesuck Point, the east limit of the harbor. The total length of these breakwaters was to be 5,880 feet, and their estimated cost is $463,540.

Work under this project was begun during the past fiscal year, and 270 linear feet of the west breakwater was built under a contract in progress.

The total amount appropriated for this improvement is $25,000.

Amount appropriated by act approved September 19, 1890		$25,000.00
June 30, 1891, amount expended during fiscal year		819.02
July 1, 1891, balance unexpended		24,180.98
July 1, 1891, outstanding liabilities	$4,918.44	
July 1, 1891, amount covered by uncompleted contracts	13,981.56	
		18,900.00
July 1, 1891, balance available		5,280.98
Amount (estimated) required for completion of existing project		438,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix D 5.)

6. *Clinton Harbor, Connecticut.*—This harbor is 10 miles west of the mouth of the Connecticut River. Its channel runs for nearly a mile inside of a beach, through which a breach was made about the year 1840, after which the channel shoaled in two places to about 4 feet depth where it had been 8 feet deep.

The project for improvement adopted in 1882 provided for closing the breach and, if that did not restore the channel depth for dredging a

channel 100 feet wide and 6 feet deep at mean low water through the shoals. The entire cost was estimated at $10,000.

A riprap dike was built across the breach in 1883; the channel depth has not changed since 1882.

During the past fiscal year the dike has been repaired.

During the ensuing year the balance of the available funds will be expended in dredging.

Future appropriations will be applied to completing the projected dredging.

July 1, 1890, balance unexpended		$252.73
Amount appropriated by act approved September 19, 1890		3,500.00
		3,752.73
Amount carried to the surplus fund	$252.73	
June 30, 1891, amount expended during fiscal year	134.78	
		387.51
July 1, 1891, balance unexpended		3,365.22
July 1, 1891, outstanding liabilities		2,190.00
July 1, 1891, balance available		1,175.22
Amount (estimated) required for completion of existing project		3,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		3,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D 6.)

7. *New Haven Harbor, Connecticut.*—The original available low-water depth up to the wharves in this harbor was about 9 feet.

The first project for deepening the channel provided for making it 13 feet deep, which was done in 1871. It was widened at different times until 1878, when a project was adopted for dredging a channel 16 feet deep and not less than 400 feet wide. In 1882 a project was adopted for building a dike to extend out from Sandy Point, with an arm parallel to the channel and 3,200 feet long, in order to contract the channel and maintain 16 feet depth on Fort Hale Bar when that depth should be obtained by dredging.

A 16-foot channel, from 400 to 600 feet wide, has been obtained all the way up the harbor, except over the Fort Hale Bar, where the depth is but 13 feet.

The shore arm and 2,089 feet of the channel arm of the Sandy Point Dike have been built.

During the past fiscal year dredging has been done to widen the channel near the head of the harbor; 139,806 cubic yards has been dredged and the channel opposite and above Long Wharf has been widened from 120 to 230 feet, with depth of 16 feet at mean low water.

Future appropriations will be applied to dredging and to extension of the dike, if required.

July 1, 1890, balance unexpended		$170.64
Amount appropriated by act approved September 19, 1890		15,000.00
		15,170.64
June 30, 1891, amount expended during fiscal year		5,332.19
July 1, 1891, balance unexpended		9,838.45
July 1, 1891, outstanding liabilities		9,120.05
July 1, 1891, balance available		718.40

Amount (estimated) required for completion of existing project	$63,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	63,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 7.)

8. *Breakwater at New Haven, Connecticut.*—In 1880 a project was adopted for making a harbor of refuge at the entrance of New Haven Harbor by the construction of two riprap breakwaters; the first to be 3,300 feet long, extending northeasterly from the light-house on Southwest Ledge, to Quixes Ledge; the second to be 4,200 feet long, extending northwesterly from Luddington Rock. The estimated cost was $1,311,134.

The river and harbor act of August 11, 1888, provided: "And the Chief of Engineers may, if deemed necessary, relocate the western breakwater, and the Secretary of War is authorized in his discretion to expend any portion of said sum in commencing its construction." The New Haven harbor commissioners proposed a plan for relocation of the western breakwater which would largely increase the anchorage afforded under the original project, and which would cost about $5,000,000. There was no doubt of the desirability of increasing the anchorage ground, but the expenditure required by this plan was larger than the present demands of commerce seemed to warrant. A plan was suggested by the officer in charge for changing the location of the western breakwater to the southwest about 6,000 feet, and constructing a breakwater 5,000 feet long, which should start at a point 1,000 feet N. 54° E. from Luddington Rock, and extend S. 54° W., crossing the rock; also for constructing a smaller breakwater from the east shore towards Quixes Ledge, to better protect the harbor from easterly storms, leaving an eastern entrance channel 800 feet wide and 13 feet deep. The cost of these works, in addition to the present estimates of $1,311,134, would be about $840,000.

Upon appropriation of $120,000 by the river and harbor act of 1890, the modifications of project above described were adopted. Further details concerning this plan and a sketch showing location of proposed works are printed in the Annual Report for 1889, Part I, pages 60 and 61; also, Appendix D 6, pages 675–685.

During the past fiscal year work was begun on the western breakwater at Luddington Rock, and up to July 1, 1891, 350 linear feet of the work had been built, extending northeasterly from the rock, under a contract still in force; with the available funds it is proposed to build the breakwater about 800 feet in each direction from Luddington Rock.

July 1, 1890, balance unexpended		$15,670.48
Amount appropriated by act approved September 19, 1890		120,000.00
		135,670.48
June 30, 1891, amount expended during fiscal year		14,756.42
July 1, 1891, balance unexpended		119,914.06
July 1, 1891, outstanding liabilities	$8,508.87	
July 1, 1891, amount covered by uncompleted contracts	99,722.60	
		108,231.47
July 1, 1891, balance available		11,682.59

Amount (estimated) required for completion of existing project	1,661,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 8.)

9. *Milford Harbor, Connecticut.*—This harbor consists of a broad open bay, from the head of which a small tidal stream extends three-quarters of a mile inland to the upper wharf. Originally the depth on the bar at the mouth of the river was less than 2 feet at mean low tide; in parts of the river the channel ran nearly bare.

Under the first project for improvement, adopted in 1872, a channel 4 feet deep and 100 feet wide was excavated through the bar, and thence 40 to 60 feet wide to the upper wharf; small jetties were built to protect the east bank from erosion, and two jetties were built to preserve the channel on the bar, at a total cost of $34,000. In 1881 a project was adopted for making the channel through the bar 8 feet deep at mean low water and 100 feet wide, at an estimated cost of $11,000.

The 8-foot channel has been completed to 100 feet width.

During the past fiscal year repairs of the jetties have been begun; these repairs will be finished during the ensuing year with funds now available.

The project for this improvement is completed.

July 1, 1890, balance unexpended	$71.95
Amount appropriated by act approved September 19, 1890	2,500.00
July 1, 1891, balance unexpended	2,571.95
July 1, 1891, outstanding liabilities	491.67
July 1, 1891, balance available	2,080.28

(See Appendix D 9.)

10. *Housatonic River, Connecticut.*—The navigable part of this river extends from Derby, Conn., to Long Island Sound, a distance of 13 miles, and was originally obstructed by several bars upon which the low-water depth was from 3 to 5 feet.

In 1871 a project was adopted for making and maintaining a channel 100 feet wide and 7 feet deep at mean low water throughout this distance. Besides the necessary dredging, it contemplated building a breakwater east of the channel over the bar at the river's mouth.

A channel of the required depth has been dredged several times through the worst bars; the present available depth over them is about 6 feet at mean low water. Drew Rock has been removed to a depth of 7 feet.

During the past fiscal year dredging has been done to maintain the channel through the bars in the river and to extend the breakwater, which is now 3,290 feet long. Contracts are now in force for further dredging and extension of breakwater, under which the channel in the river will be deepened and the breakwater will be extended about 1,000 feet, making it about 4,300 feet long.

July 1, 1890, balance unexpended		$21,428.01
Amount appropriated by act approved September 19, 1890		35,000.00
		56,428.01
June 30, 1891, amount expended during fiscal year		16,231.55
July 1, 1891, balance unexpended		40,196.46
July 1, 1891, outstanding liabilities	$898.47	
July 1, 1891, amount covered by uncompleted contracts	32,876.53	
		33,775.00
July 1, 1891, balance available		6,421.46

Amount (estimated) required for completion of existing project.....$132,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix D 10.)

11. *Bridgeport Harbor, Connecticut.*—The available depth in this harbor was originally 5 feet at mean low water.

The first project for improvement provided for an 8-foot channel over the outer and inner bars. This was dredged on the outer bar in 1837, and on both bars in 1853. In 1871 a project was adopted for making a channel 12 feet deep and 100 feet wide, subsequently modified to 300 feet, and for building a jetty on the east shore to check the influx of sand. This was accomplished in 1882, and a new project was adopted for widening to 600 feet the channel from the Inner Beacon to the Naugatuck Railroad wharf, to provide for vessels driven in by bad weather, without blocking the main channel. The estimated cost of the latter project was $60,000; it is very nearly completed. A small area remains near the Inner Beacon, which it is considered desirable to dredge. The project was extended in 1888 to include widening the channel above the railroad wharf in order to relieve the crowding at that point, and was further extended by act of Congress authorizing the expenditure of the appropriation of 1888 toward dredging a 9-foot channel up to the head of the upper harbor, above the bridges, and by the river and harbor act of 1890, which directed the beginning of the breakwater from the Tongue to the Inner Beacon. The total estimated cost of these extensions was $65,000, of which $30,000 has been appropriated.

During the past fiscal year 750 tons of stone have been delivered in the breakwater between the Tongue and the Inner Beacon, partly finishing 300 linear feet of the shore end under a contract in progress. A contract has been made for dredging above the bridges, and work will be begun early in the ensuing year.

It is expected, under existing contracts, to extend the breakwater over the full distance to the Beacon, with reduced cross section, and to complete as nearly as practicable the channel above the bridges.

July 1, 1890, balance unexpended		$1,328.75
Amount appropriated by act approved September 19, 1890		20,000.00
		21,328.75
June 30, 1891, amount expended during fiscal year		1,427.40
July 1, 1891, balance unexpended		19,901.35
July 1, 1891, outstanding liabilities	$1,067.50	
July 1, 1891, amount covered by uncompleted contracts	15,728.50	
		16,796.00
July 1, 1891, balance available		3,105.35

Amount (estimated) required for completion of existing project..... 35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix D 11.)

12. *Black Rock Harbor, Connecticut.*—This harbor consists of a bay partly sheltered by Fairweather Island, and of two small streams extending inland from the head of the bay. The depth in Cedar Creek, the more important of these streams, was from 2 to 4 feet at mean low water, and the channel was narrow and very crooked.

The project for improvement, submitted in 1883, includes dredging a

channel 3,300 feet long, 80 feet wide, and 6 feet deep, to extend up to Cedar Creek, and a breakwater from Fairweather Island to the mainland. The estimated cost was $80,000.

The breakwater has been built to the full length, but not to the width and height projected. The proposed channel has been carried up to the head of the harbor, with rather less than the projected width in places.

A contract is now in force for widening the channel as required; work will be begun and completed during the present season.

July 1, 1890, balance unexpended	$1,336.43
Amount appropriated by act approved September 19, 1890	5,000.00
	6,336.43
June 30, 1891, amount expended during fiscal year	1,219.05
July 1, 1891, balance unexpended	5,117 38
July 1, 1891, amount covered by uncompleted contracts	3,796.00
July 1, 1891, balance available	1,321.38
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 12.)

13. *Norwalk Harbor, Connecticut.*—This harbor consists of the tidal part of Norwalk River, extending from Norwalk, Conn., to the river's mouth, a distance of about 3 miles. South Norwalk is on the west bank of the river about 1½ miles below Norwalk. Originally the depth up to South Norwalk was about 5 feet at mean low water; between there and Norwalk the river bed ran nearly bare.

The first project for improvement contemplated a channel 100 feet wide and 6 feet deep to Norwalk. In 1881 the project was modified to provide for a depth of 8 feet below South Norwalk. The last estimate upon this work placed the cost from commencement at $84,000.

Some parts of the river have required dredging several times.

A channel has been dredged 100 feet wide and 8 feet deep up to South Norwalk, and thence to Norwalk from 60 to 100 feet wide and 6 feet deep. This channel is now in fair condition, but was narrowed from washing in at the sides.

During the past fiscal year a contract for dredging to restore the channel has been made; work under it will be begun and completed during the present season.

With the available funds the project for this improvement will be practically completed.

July 1, 1890, balance unexpended	$1,051.12
Amount appropriated by act approved September 19, 1890	4,000.00
	5,051.12
June 30, 1891, amount expended during fiscal year	283.91
July 1, 1891, balance unexpended	4,767.21
July 1, 1891, amount covered by uncompleted contracts	2,920.00
July 1, 1891, balance available	1,847.21

(See Appendix D 13.)

14. *Wilson Point Harbor, Connecticut.*—This harbor is a bay on the north shore of Long Island Sound, sheltered from all storms except southerly ones; its natural depth of 16 feet at the mouth shoaled to

about 5 feet at low water at the wharves of the New England Terminal Company, a corporation formed to secure water privileges for the Housatonic Railroad system and its connections.

In 1888, $25,000 was appropriated for this improvement as a part of Norwalk Harbor, and a project was adopted for making a channel 300 feet wide and 15 feet deep up to the vicinity of the wharves; the required depth was secured with width of 400 feet.

In 1890, $30,000 was appropriated for this harbor, and a project for its expenditure was adopted, under which the channel has been made 480 feet wide with additional width of 200 feet for 750 feet on the east side near the wharves.

With the remaining funds, during the ensuing year, the channel will be widened and extended as far as necessary.

No further appropriation is required.

Amount appropriated by act approved September 19, 1890	$30,000.00
June 30, 1891, amount expended during fiscal year	11,784.31
July 1, 1891, balance unexpended	18,215.69
July 1, 1891, outstanding liabilities	30.00
July 1, 1891, balance available	18,185.69

(See Appendix D 14.)

15. *Five Mile River Harbor, Connecticut.*—This harbor is a small inlet, over a mile long and from 300 to 800 feet wide, on the north shore of Long Island Sound. The natural low-water depth at the mouth is about 3 feet, shoaling to zero half way up the harbor.

The project for improvement proposed in a report on a survey made in 1886, and adopted under an appropriation of $5,000, made August 11, 1888, provides for dredging a channel 8 feet deep at mean low water, 100 feet wide and about 6,000 feet long, extending to the head of the harbor; the cost was estimated at $25,000.

The total amount appropriated for this improvement is $10,000.

The channel has been dredged 50 feet wide and 1,500 feet long.

It will be extended during the present season under a contract made during the past fiscal year.

July 1, 1890, balance unexpended	$179.25
Amount appropriated by act approved September 19, 1890	5,000.00
	5,179.25
June 30, 1891, amount expended during fiscal year	52.38
July 1, 1891, balance unexpended	5,126.87
July 1, 1891, amount covered by uncompleted contracts	3,796.00
July 1, 1891, balance available	1,330.87

Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 15.)

16. *Stamford Harbor, Connecticut.*—This harbor consists of a bay on the north shore of Long Island Sound and of the tidal part about three-quarters of a mile long of Mill River. The original depth in this part of the river at mean low water was from 1 to 3 feet, gradually increasing in the bay to a depth of 12 feet.

The project for improvement, proposed in 1883 and adopted in 1886, provides for dredging a channel 80 feet wide and 5 feet deep at mean

low water from the bay to the head of the harbor, at an estimated cost of $20,000.

Fifteen thousand dollars was expended in making a channel 5 feet deep, with width of 80 feet or over for more than half its projected length and 50 feet for the rest of the distance.

The appropriation made by the river and harbor act of 1890 has been partly expended in dredging; with the remainder the project will be completed.

July 1, 1890, balance unexpended	$513.86
Amount appropriated by act approved September 19, 1890	5,000.00
	5,513.86
June 30, 1891, amount expended during fiscal year	2,226.68
July 1, 1891, balance unexpended	3,287.18
July 1, 1891, oustanding liabilities	836.20
July 1, 1891, balance available	2,450.98

(See Appendix D 16.)

17. *Port Chester Harbor, New York.*—This harbor consists of a bay opening into Long Island Sound at the mouth of Byram River, and of the lower part of the river itself, which is navigable for about a mile above its mouth.

The original available depth in the river was not more than a foot at low water, and Salt Rock in the river and Sunken Rock in the bay were considered dangerous obstructions.

The project for improvement, adopted in 1871, provided for the removal of these rocks to 9 and 11 feet depth respectively, and for the construction of a breakwater at Byram Point, at the mouth of the harbor, the estimated cost being $96,632.

In 1884 the project was extended to provide for dredging a channel 2½ feet deep and from 60 to 100 feet wide from the bay to the vicinity of the village wharves.

In 1888 the project was further modified to omit the removal of Sunken Rock and to build a breakwater from that rock to Byram Point, which should also serve as a beacon on the rock; a revised estimate, made in 1890, in accordance with the modification, reduced the cost of completion by about $40,000.

Salt Rock has been removed to the required depth of 9 feet at mean low water, a channel 2½ feet deep and from 60 to 100 feet wide has been completed to within 150 feet of the Port Chester Bridge, with 25 feet width to the bridge, and 585 linear feet of the breakwater from Sunken Rock towards Byram Point have been built, 297 feet of which were built during the past fiscal year.

The total amount appropriated for this improvement is $32,000.

Future appropriations will be applied to completing the breakwater and to maintaining or enlarging the dredged channel.

July 1, 1890, balance unexpended	$11.21
Amount appropriated by act approved September 19, 1890	5,000.00
	5,011.21
June 30, 1891, amount expended during fiscal year	3,952.52
July 1, 1891, balance unexpended	1,058.69
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 17.)

18. *Larchmont Harbor, New York.*—This is a bay about half a mile wide and extending three-quarters of a mile inland, with depths gradually diminishing from 18 feet at and near the mouth. The mouth of the bay was obstructed by two rocks (Umbrella Rock and Huron Rock), always covered; and owing to its width the harbor anchorage was little protected from easterly and southerly storms.

A survey was ordered by Congress in 1888, and afterwards a project was adopted for connecting Umbrella Rock with the west shore and Huron Rock with the east shore by riprap breakwaters, which would sufficiently mark the rocks and would cover the harbor; the estimated cost of the project was $105,000.

Five thousand dollars has been appropriated for this improvement and applied to constructing 74 linear feet of Umbrella breakwater and 64 linear feet of Huron breakwater, the location being over the rocks.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	4,585.72
July 1, 1891, balance unexpended	414.28
July 1, 1891, outstanding liabilities	33.33
July 1, 1891, balance available	380.95
Amount (estimated) required for completion of existing project	100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 18.)

19. *Echo Harbor, New Rochelle, New York.*—The channel of this harbor was obstructed by two ledges, Start Rock and Sheepshead Reef, the former bare at low water, the latter covered to a depth of about a foot.

The project for improvement adopted in 1875 provided for the removal of these rocks to 7 and 9 feet depth, respectively. The estimated cost was $38,955.58.

Twenty-two thousand dollars has been appropriated for this harbor. Start Rock has been wholly removed to 7 feet depth, and Sheepshead Reef partly removed to 9 feet depth; a narrow channel has also been dredged up the harbor.

During the past fiscal year nothing was done.

Amount (estimated) required for completion of existing project	$17,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	17,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 19.)

20. *New Rochelle Harbor, New York.*—This harbor consists mainly of a rather narrow and crooked channel lying between rocky islands.

The project for improvement adopted in 1881 provided for the removal of two rocks and for dredging and removing a reef to secure a channel 8 feet deep and 100 feet wide between Hunter and Glen Islands. The estimated cost was $40,825.

Thirty-five thousand dollars has been appropriated for this project. The channel around Glen Island has been made 8 feet deep and 100 feet wide, and the reef has been removed to 7½ feet depth; one of the rocks, Corning Rock, has been removed to the required depth of 12 feet; upon the other, Rock "C," no work has been done.

During the past fiscal year no work was done.

There is no immediate need for further work under this project, the removal of Rock "C" not being contemplated at present.

July 1, 1890, balance unexpended	$219.93
June 30, 1891, amount expended during fiscal year	219.93

(See Appendix D 20.)

21. *East Chester Creek, New York.*—This is a small tidal stream emptying into Pelham Bay. It was navigable at high tide only, for vessels drawing 7 feet, up to Lockwood, a distance of 2¼ miles. The rise of tide is 7.1 feet.

The project for improvement, adopted in 1872, and subsequently modified, provided for a channel 9 feet deep at mean high water, extending to a point 3,000 feet above Lockwood and terminating at the upper end in a tidal basin. Part of the lower course of the channel was to be protected by dikes and the whole work was estimated to cost $221,000.

Sixty-four thousand dollars has been appropriated for this improvement.

The channel has been made 9 feet deep at high water and 125 feet wide to the head of Goose Island, one-half mile from the mouth of the creek, thence to Town Dock 100 feet wide, and thence to Lockwood nearly the same width. Above Town Dock 1,235 linear feet of diking have been built on the east side of the channel.

Nothing was done during the past fiscal year.

A lay-out for the channel above Lockwood was surveyed in 1889, and an unsuccessful effort was made to obtain consent of owners to the depositing of material to be dredged upon the adjacent marsh lands.

It seems probable that this consent will soon be obtained, in which case work above Lockwood will be begun with the funds now available.

The lower channel now holds its depth fairly without dikes, and it is doubtful whether they will ever be needed; a revised estimate of the cost of completion of the project, omitting the dikes, is placed by the officer in charge at $55,000, being a reduction of $97,100 from previous estimates and making the total cost from begining $124,000.

July 1, 1890, balance unexpended	$7,141.03
July 1, 1891, balance unexpended	7,141.03
Amount (estimated) required for completion of existing project	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	55,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 21.)

22. *Greenport Harbor, New York.*—This harbor, at the eastern end of Long Island, is exposed to easterly storms. Its anchorage ground, which was sheltered by Joshua Point, has materially shoaled by the erosion of the point and by the influx of drifting sand.

The project of improvement, adopted in 1882, provided for the construction of a riprap breakwater extending from Joshua Point 1,700 feet in a southeasterly course to arrest drifting sand, to check the erosion of the point, and to increase the sheltered area. Its cost was estimated at $46,000.

One thousand five hundred and seventy linear feet of the breakwater have been built.

In 1890 the project was modified to provide for increasing the height of the breakwater from 3 feet to 5 feet above high water instead of extending it, and to apply the rest of the estimated amount for completion to dredging and enlarging the anchorage basin.

Work has been begun upon increasing the height of the breakwater, and dredging under open market transaction is soon to be commenced.

Future appropriations will be applied to dredging the anchorage basin in accordance with the modified project.

Amount appropriated by act approved September 19, 1890		$5,000.00
June 30, 1891, amount expended during fiscal year		494.15
July 1, 1891, balance unexpended		4,505.85
July 1, 1891, outstanding liabilities	$804.85	
July 1, 1891, amount covered by uncompleted contracts	748.20	
		1,553.05
July 1, 1891, balance available		2,952.80
Amount (estimated) required for completion of existing project		11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		11,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D 22.)

23. *Harbor at Port Jefferson Inlet, New York.*—This harbor is a large and deep inland bay with a narrow entrance or inlet, outside of which was originally a shoal with 3 feet depth at low water. The location of the inlet is one of the most exposed on Long Island Sound.

Under a project adopted in 1871 and modified in 1873 and 1877, an east jetty 1,390 feet long, and a west jetty 940 feet long, were built, both with scant cross section, and a channel 8 feet deep and 100 feet wide was dredged through the bar. The work was completed in 1883, at a total cost of $79,000.

By order of Congress an examination of Port Jefferson Inlet was made in 1888, and subsequently a project was adopted for repairing and enlarging the jetties, and dredging to make the channel 10 feet deep and 200 feet wide, at an estimated cost of $90,000.

Twenty-five thousand dollars has been appropriated under this project; the breakwaters are being enlarged and repaired under a contract in progress, and the remainder of the appropriation is to be expended in dredging.

July 1, 1890, balance unexpended		$374.76
Amount appropriated by act approved September 19, 1890		25,000.00
		25,374.76
June 30, 1891, amount expended during fiscal year		326.87
July 1, 1891, balance unexpended		25,047.89
July 1, 1891, outstanding liabilities	$2,335.31	
July 1, 1891, amount covered by uncompleted contracts	11 302.00	
		13,637.31
July 1, 1891, balance available		11,410.58
Amount (estimated) required for completion of existing project		65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D 23.)

24. *Huntington Harbor, New York.*—This is a tidal inlet extending southward from Huntington Bay to the village of Huntington. It is about 2 miles long, quite narrow, and landlocked, and has a natural available depth of nearly 8 feet at mean low water up to within three-fourths mile of the head of the harbor, where the low-water depth shoaled gradually to zero.

In 1872–'73 a channel 8 feet deep and 150 feet wide was dredged in the upper part of the harbor by the United States at a cost of $22,500. Within 10 years following this had nearly filled up.

In 1884 a survey was ordered by Congress, and subsequently a project for improvement was adopted, providing for redredging a channel 8 feet deep and 100 feet wide up to the upper wharves at an estimated cost of $40,000. The estimate also includes a pile protection for part of the channel.

Ten thousand dollars has been appropriated for this project, and a contract has been made under which it will be expended during the present season in dredging.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	104.40
July 1, 1891, balance unexpended	9,895.60
July 1, 1891, amount covered by uncompleted contracts	7,155.00
July 1, 1891, balance available	2,740.60
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 24.)

25. *Glen Cove Harbor, New York.*—This harbor is an inlet on the east side of Hempstead Bay, which is accessible only at high tide, and a breakwater was needed to shelter vessels while at anchor waiting for tides.

The project for improvement, adopted in 1888, provides for a riprap breakwater about 2,500 feet long, extending in a west southwesterly direction from the northwest corner of the Glen Cove Dock, the top to be 5 feet wide and 3 feet above mean high water, and slopes to be 1 on 1; its estimated cost was $201,960.

Up to the beginning of the past fiscal year 765 linear feet of breakwater had been built, the cross section being reduced to admit of more rapid extension.

During the past fiscal year 59 linear feet of breakwater were built under a contract still in progress; its present total length is 824 feet.

Future appropriations will be applied to extending the breakwater.

July 1, 1890, balance unexpended		$109.62
Amount appropriated by act approved September 19, 1890		15,000.00
		15,109.62
June 30, 1891, amount expended during fiscal year		370.32
July 1, 1891, balance unexpended		14,739.30
July 1, 1891, outstanding liabilities	$2,527.53	
July 1, 1891, amount covered by uncompleted contracts	9,580.80	
		12,108.33
July 1, 1891, balance available		2,630.97
Amount (estimated) required for completion of existing project		166,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D 25.)

26. *Flushing Bay, New York.*—Before improvement the available depth in this broad, shallow bay and in the channel leading up to Flushing was less than 4 feet at mean low water.

The project for improvement, adopted in 1879, contemplated building 16,700 feet of diking to form a tidal basin, which, by filling and discharging through the main channel, would maintain a channel depth of 6 feet or more at mean low water after once dredging; the bottom is soft mud. The estimated cost of this work was $173,500. A modification of the project, made in 1888, omits part of the diking.

The present length of the dike is 4,663 feet; it is not proposed to extend it further.

The total amount appropriated for this improvement is $105,000.

During the past fiscal year the dike has been partly filled with riprap, and a contract has been made for dredging, to begin early in the ensuing year.

Further appropriations will be applied to dredging to widen and maintain the channel.

July 1, 1890, balance unexpended	$2,143.41
Amount appropriated by act approved September 19, 1890	20,000.00
	22,143.41
June 30, 1891, amount expended during fiscal year	6,643.39
July 1, 1891, balance unexpended	15,500.02
July 1, 1891, outstanding liabilities	112.10
July 1, 1891, balance available	15,387.92
Amount (estimated) required for completion of existing project	68,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 26.)

27. *Patchogue River, New York.*—This is a shallow tidal inlet extending about a mile northward from the shore of Great South Bay, Long Island, to the village of Patchogue. The natural depth in the stream and over a bar at the mouth was from 2 to 3 feet at mean low water, and the rise of tide is about 1 foot.

In 1880, and again in 1886, examinations were made by order of Congress, and subsequently a project was adopted for making a channel 6 feet deep at mean low water and 60 feet wide up to the village wharves, to be protected at the mouth by a jetty on the west side, at an estimated cost of $40,000.

Fifteen thousand dollars has been appropriated for work under this project.

About 150 feet of the jetty has been constructed under a contract in progress and the available balance of the appropriation will be applied to dredging during the current year.

Amount appropriated by act approved September 19, 1890		$15,000.00
June 30, 1891, amount expended during fiscal year		156.18
July 1, 1891, balance unexpended		14,843.82
July 1, 1891, outstanding liabilities	$1,385.00	
July 1, 1891, amount covered by uncompleted contracts	7,140.00	
		8,525.00
July 1, 1891, balance available		6,318.82
Amount (estimated) required for completion of existing project		25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D 27.)

28. *Brown's Creek, Sayville, New York.*—This is a narrow stream, extending northward from Great South Bay to the Sayville highway bridge, above which it is wholly a fresh water creek. The natural depth in the creek is from 1 to 3 feet at low tide, and on a bar at the mouth it is less than 1 foot.

A survey was made by order of Congress in 1889, and a project was adopted for making the creek 100 feet wide and 4 feet deep at mean low water, the entrance channel to be protected by riprap jetties on either side, at a total estimated cost of $46,000.

Twelve thousand dollars has been appropriated for work under this project, and under an existing contract the shore ends of the jetties will be built this season, after which the available funds will be applied to deepening the entrance channel.

Amount appropriated by act approved September 19, 1890	$12,000.00
June 30, 1891, amount expended during fiscal year	70.84
July 1, 1891, balance unexpended	11,929.16
July 1, 1891, amount covered by uncompleted contracts	5,600.00
July 1, 1891, balance available	6,329.16
Amount (estimated) required for completion of existing project	34,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix D 28.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Stony Creek River at Stony Creek, Connecticut*, was made by the local engineer in charge, Colonel Houston, and report thereon submitted. It is the opinion of Colonel Houston, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 124, Fifty-first Congress, second session. (See also Appendix D 29.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Colonel Houston, and reports thereon submitted. It is the opinion of Colonel Houston, based upon the facts and reasons given, that these localities are worthy of improvement. The reports of the preliminary examinations containing sufficient information to indicate to Congress the probable cost of the work required, no further surveys appear to be necessary at this time.

1. *Shaw's Cove, New London Harbor, Connecticut.*—The improvement asked for is a channel 100 feet wide and 12 feet deep at mean low water, extending from the drawbridge along the north and west side of the cove a total length of about 2,000 feet; and an anchorage basin in the bend of the channel of the same depth and about 400 by 800 feet. The estimated cost of this work is $48,000. Report transmitted to Congress, and printed as House Ex. Doc. No. 73, Fifty-first Congress, second session. (See also Appendix D 30.)

2. *Connecticut River, Connecticut, from Long Island Sound to Hartford, with a view to such improvement as will keep the channel from shifting its course at certain places.*—Colonel Houston states that in his opinion Connecticut River from Long Island Sound to Hartford is worthy of

improvement. The estimates for work required were submitted in annual report on Connecticut River for fiscal year ending June 30, 1890, and are as follows:

Completing jetties at mouth of river	$60,000
Dredging channel between them	20,000
Raising dike at Hartford	50,000
	130,000
Annual cost of maintaining channel from Hartford to Long Island Sound by dredging	10,000

Report transmitted to Congress, and printed as House Ex. Doc. No. 86, Fifty-first Congress, second session. (See also Appendix D 31.)

3. *Connecticut River, Connecticut, below Hartford.*—The report on this locality is included in that for Connecticut River from Long Island Sound to Hartford. Printed as House Ex. Doc. No. 86, Fifty-first Congress, second session. (See also Appendix D 31.)

4. *Saugatuck River, Connecticut.*—The following estimates for improvement are submitted:

1. For improvement of the natural channel:	
a. To secure a width of 100 feet and depth of 6 feet	$40,000
Annual cost of maintenance	2,000
b. To secure a width of 60 feet and depth of 4 feet	10,000
2. For enlarging the canal (or short cut) to make a channel 100 feet wide and 5 feet deep	21,000
Annual cost of maintenance	2,500

In the opinion of Colonel Houston the improvement of the natural channel should precede any work on the canal or short cut. Report transmitted to Congress, and printed as House Ex. Doc. No. 179, Fifty-first Congress, second session. (See also Appendix D 32.)

5. *Mattituck Bay, Suffolk County, New York, for breakwater.*—The improvement proposed contemplates construction of parallel jetties 400 feet apart at the entrance of the bay, extending to the 9-foot curve in Long Island Sound; and formation of a channel 7 feet deep at low tide up to the tide mill and 7 feet deep at high water thence to Mattituck, and 100 feet wide at the entrance and 80 feet wide from there up. The cost of the work is estimated at $83,000. (See Appendix D 33.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Colonel Houston, and reports thereon submitted. It is the opinion of Colonel Houston, based upon the facts and reasons given, that these localities are worthy of improvement. This opinion being concurred in by me, Colonel Houston was charged with and has completed their survey and submitted reports thereon.

1. *Stamford Harbor, Stamford, Connecticut.*—The improvement proposed contemplates enlarging the channel heretofore improved by the United States to a width of 150 feet and depth of 7 feet at mean low water, and dredging out the basin at the head of the harbor to the established harbor lines and to a depth of 7 feet. The estimated cost of this work is as follows:

Dredging channel 150 feet wide and 7 feet deep	$46,000
Dredging basin at head of harbor	49,000
Total	95,000

In addition it is desired that the outer harbor be protected by the construction of a breakwater extending about 1,800 feet southwesterly from Shippan Point, at an estimated cost of $77,000; this would shelter

from easterly storms an anchorage of about 50 acres area with 12 feet depth at mean low water.

Colonel Houston states—

The dredging in the upper harbor is the more urgently needed and should be the first improvement undertaken.

(See Appendix D 34.)

2. *Cos Cob or Miamus River, Connecticut.*—The improvement proposed contemplates the formation of a low-water channel 8 feet deep and 150 feet wide up to the railroad bridge, and 100 feet wide from the bridge to Miamus, at an estimated cost of $36,000.

(See Appendix D 35.)

3. *Peconic River, Suffolk County, New York.*—The following plan and estimate for improvement are presented:

For channel 75 feet wide and 6 feet deep at mean low water up to the head of Merritt Bay	$22,500.00
For turning basin in Merritt Bay, 250 feet by 400 feet and 6 feet deep	5,100.00
Contingencies and supervision	3,400.00
	31,000.00
To extend the channel 2,000 feet above Merritt Bay, with a width of 75 feet for the first 1,000 feet and of 50 feet for the remainder	11,100.00
Contingencies, etc	1,900.00
	44,000.00

(See Appendix D 36.)

4. *Sag Harbor, Suffolk County, New York, for breakwater.*—The improvement proposed, with a view to the protection from northeast storms, of the water front where the wharves are located, contemplates the construction of a riprap breakwater, with a height of 8 feet above mean low water, top width of 5 feet, side slopes of 1 on 1, and total length of 3,180 feet, extending from Conklins Point north by west about 1,330 feet, and thence nearly northwest 1,850 feet to the 9-foot curve; the estimated cost of this breakwater is $71,000.

(See Appendix D 37.)

IMPROVEMENT OF HUDSON RIVER; OF HARBORS AT SAUGERTIES AND RONDOUT, AND WAPPINGER'S CREEK; OF NEW YORK HARBOR AND RIVERS IN ITS VICINITY, NEW YORK; AND OF RARITAN BAY, NEW JERSEY.

Officer in charge, Lieut. Col. G. L. Gillespie, Corps of Engineers, with Lieut. Harry Taylor, Corps of Engineers, under his immediate orders.

1. *Hudson River, New York.*—The improvement of this river has been restricted by the wording of the appropriation acts to that part of it lying between Troy, at the head of navigation, 6 miles above Albany, and New Baltimore, about 14 miles below Albany.

Before the improvement was begun, the navigable depth in the channel between New Baltimore and Albany was 7½ feet at mean low water; between Albany and Troy, 4 feet.

The plan of improvement adopted in 1867 proposed making the navigable depth between New Baltimore and Albany 11 feet, and between Albany and Troy 9 feet. This was to be accomplished by the construction of longitudinal dikes to direct the currents, and by dredging.

The estimated cost of making this improvement, prepared in 1882, subject to be increased annually, was $1,078,304. In 1889 the estimated cost was $1,424,435.

The amount expended to June 30, 1890, inclusive of outstanding liabilities, was $1,074,485.69, of which sum a large part has, however, from the necessity of the case, been applied partly to the repair of decaying dikes. At that date the dikes provided for in the project of improvement, so far as built, have resulted in securing a channel depth of 10 feet nearly all the way from New Baltimore to Albany, and of 8 feet nearly all the way from Albany to Troy. The shoal spots make the navigable depths on those parts of the river 9½ feet and 7½ feet respectively.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $96,172.36, and was applied to the repair of the dikes; to the construction of new dikes; to dredging at Fish House, Bogart Light, Winnies, and Washington Bars; and to the removal of Dittingers Rock, opposite Van Wies Point.

In compliance with the provisions of the river and harbor act approved September 19, 1890, a Board of Engineers, consisting of Lieut. Col. G. L. Gillespie, Maj. Amos Stickney, and Maj. C. W. Raymond, Corps of Engineers, was constituted by the Secretary of War to examine the obstructions to navigation in Hudson River, and submit project and estimate for its improvement. The report of the Board will be submitted when received.

July 1, 1890, balance unexpended		$63,491.23
Amount appropriated by act approved September 19, 1890		150,000.00
		213,491.23
June 30, 1891, amount expended during fiscal year		85,148.52
July 1, 1891, balance unexpended		128,342.71
July 1, 1891, outstanding liabilities	$11,023.84	
July 1, 1891, amount covered by uncompleted contracts	59,679.78	
		70,703.62
July 1, 1891, balance available		57,639.09
Amount (estimated) required for completion of existing project		145,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		145,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix E 1.)

2. *Harbor at Saugerties, New York.*—This harbor is formed by the mouth of Esopus Creek, which empties into the Hudson River, on the west bank, about 100 miles above New York City.

The bar at the entrance at the time of original examination, made in November, 1883, with the view of preparing estimates for improvement, had a navigable depth of 3 feet only at mean low water, and the distance between the 6-foot curves across it was 1,100 feet. The harbor could therefore be entered only at high water even by the smallest class of vessels.

The plan of improvement which was adopted in 1887 provided for securing a depth of 8 feet, mean low water, from the entrance to the head of navigation, 1¾ miles, by the construction of two parallel dikes, each 2,300 feet long, 260 feet apart on the inside, and 280 feet apart on the outside, and by dredging, if found necessary, 30,000 cubic yards of material from the channel between the dikes.

The estimated cost of the improvement was $52,000; the amount expended upon the project up to the close of the fiscal year ending June 30, 1890, inclusive of outstanding liabilities, was $31,278.07. At that date the South Dike had been completed, and its length by actual

measurement was 2,363½ feet; the North Dike had been completed for a length of 809½ feet; and the shoal in front of Sheffield's paper mill had been dredged to afford a channel 50 feet wide and 7 to 8 feet deep. The channel across the bar was 200 feet wide and 9 feet deep, mean low water.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $5,021.04, and was applied towards the construction of 1,270 feet of piled dike on the north side of the creek.

The existing navigable depth from the entrance to the head of navigation is 9 feet, mean low water, in a channel from 100 to 300 feet wide.

July 1, 1890, balance unexpended		$721.93
Amount appropriated by act approved September 19, 1890		10,000.00
		10,721.93
June 30, 1891, amount expended during fiscal year		3,043.69
July 1, 1891, balance unexpended		7,678.24
July 1, 1891, outstanding liabilities	$1,977.35	
July 1, 1891, amount covered by uncompleted contracts	3,078.83	
		5,056.18
July 1, 1891, balance available		2,622.06
Amount (estimated) required for completion of existing project		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix E 2.)

3. *Harbor at Rondout, New York.*—This harbor is formed by the mouth of Rondout Creek, which empties into the Hudson River on its west side about 90 miles above the city of New York, and is the eastern terminus of the Delaware and Hudson Canal. The creek is a tidal stream for 3 miles above its mouth, and prior to 1871 all improvements had been made by private parties.

The Government made a survey of the harbor in 1869, and the available depth of water then in the channel was only 7 feet at mean low water. The project of improvement, based on this survey, was for the formation and maintenance of a channel 100 feet wide and 14 feet deep, mean low water, at the mouth of the creek, to be obtained by means of dikes and dredging. Two parallel channel dikes, 350 feet apart at the entrance, were to be built outward, toward and into the Hudson River, and a branch dike up stream to protect the north dike against destruction by ice.

The estimated cost of the project was $172,500.

The project was completed in 1880 at an actual cost of $90,000 only. At that time the length of the north dike was 2,200 feet, and that of the south dike 2,800 feet, and there was a channel between them 50 feet wide and 13½ feet deep, mean low water, and 100 feet wide and 12 feet deep, mean low water.

The appropriations which have been made since 1880 have been applied exclusively to the repair of the dikes.

The amount expended upon the project and upon repairs up to the close of the fiscal year ending June 30, 1890, was $101,500, at which date the navigable channel was 100 feet wide and from 12½ to 13½ feet deep, mean low water. The dikes were built originally of timber and stone to the height of mean high water, but the timber has since become so damaged by age and by the ice that the stone filling in many places has

fallen out from between the rows of piles, and the height of the dikes has been correspondingly lowered.

No funds were expended upon this improvement during the past fiscal year.

Sealed proposals will be opened July 16, for the work contemplated by the project for the expenditure of the appropriation of $5,000, act of September 19, 1890.

The work to be done consists of repairs to all the dikes where the stone has settled or the waves undermined foundations. When the proposed repairs are completed, the dikes will be in fair condition.

Amount appropriated by act approved September 19, 1890	$5,000.00
July 1, 1891, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix E 3.)

4. *Wappinger's Creek, New York.*—Wappinger's Creek is a small stream which empties into the Hudson River on left bank, one-half mile below the village of New Hamburg, N. Y. The navigable portion, extending from the mouth to Wappinger's Falls, is 2 miles long, approximately, and affords navigation to small boats drawing not exceeding 6 feet in a water way which has a width varying from 25 feet to 75 feet.

The project for its improvement contained in the report upon the survey November 11, 1889, to comply with the river and harbor act, August 11, 1888, contemplates a channel 80 feet wide and 8 feet deep from the mouth to the falls. The estimated cost of the improvement was $13,000. The amount appropriated by the river and harbor act, September 19, 1890, was $13,000.

The work was advertised according to law and the sealed proposals received in answer thereto were publicly opened November 19, 1890, and being excessive in price were all rejected. It was readvertised June 8, 1891, and sealed proposals will be again opened July 16, 1891.

Amount appropriated by act approved September 19, 1890	$13,000.00
June 30, 1891, amount expended during fiscal year	80.33
July 1, 1891, balance unexpended	12,919.67

(See Appendix E 4.)

5. *Harlem River, New York.*—The Harlem River and Spuyten Duyvil Creek are both included in this improvement. The head of navigation in the former is practically at the High Bridge, about 5 miles from its junction with the East River; in the latter at Kingsbridge, about $1\frac{3}{4}$ miles from the Hudson River, for vessels of 8 feet draft, at high water only.

The object of the improvement is to form a navigable channel between the East and Hudson Rivers.

The project for the improvement as originally adopted in 1875 was for a channel 350 feet wide and 15 feet deep at mean low water. In 1879 the project was so far modified as to increase the width of the channel in the Harlem River and Spuyten Duyvil Creek to 400 feet, and retaining the original width of 350 feet through Dyckman Meadow, but increasing the depth to 18 feet, mean low water. This project was revised in 1886 by narrowing the channel immediately north of High Bridge, where it skirts the Ogden estate on the east bank, to a least width of 375 feet.

The estimated cost of the work was $2,700,000; the amount expended upon the improvement up to the close of the fiscal year ending June 30,1890, inclusive of outstanding liabilities, was $367,060.22. At that date the excavation of the canal prism had been carried down to grade at the eastern end of the cut west of Kingsbridge road for a length of 317 feet, measured along the axis of the canal, and to nearly the full width of the channel; and at the western end for a length of 438 feet and width of 124 feet, giving a total area of 146,110 square feet, where the excavation had reached grade; over a large additional area the general level of the surface had been reduced to a plane but a few feet above grade.

The dam to the east of the Kingsbridge road, to keep out the waters of the Harlem River from the cut, had been completed, the site of the work drained, and the removal of material under the second contract had been begun.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $121,544.79. At that date the excavation of the section of canal prism lying to the west of old Kingsbridge road was carried down to grade over an area of 57,465 square feet, giving a total area of 203,575 square feet where the excavation has reached grade, and completing the section of the cut to be excavated under the contract of December 15, 1887, with the exception of a core of rock left standing in the center of the excavation for temporary use as a roadway, and a spur of rock in the southwest end over which the tramway for transporting the broken stone to the dumping ground passes. Both these ledges cover an area of 42,000 square feet, and are now in process of removal. The old Kingsbridge road, where it crosses the canal, has been closed, and the material composing it excavated down to the underlying rock surface, and a temporary roadway over the east dam has been opened to public traffic. The earth, turf, and meadow sod between the east dam and the westerly limit of the contract of August 5, 1889, has been nearly all excavated down to grade, and the rock excavation begun and grade reached over an area of 600 square feet.

Nearly all the rock to be removed under the contract of March 9, 1891, has been stripped of earth, and the excavation in the rock has been carried down to grade over an area of 1,400 square feet. The dredging in the Harlem River began near Fordham foot-bridge, and was carried northward towards Kingsbridge in a water way of 600 feet long, 75 to 150 feet wide, and 9 feet deep, at mean low water. The quantity removed to the close of the fiscal year was 40,204 cubic yards. The contract for work west of west dam was not begun.

July 1, 1890, balance unexpended		$163,848.51
Amount appropriated by act approved September 19, 1890		250,000.00
		413,848.51
June 30, 1891, amount expended during fiscal year		71,549.56
July 1, 1891, balance unexpended		342,298.95
July 1, 1891, outstanding liabilities	$49,995.23	
July 1, 1891, amount covered by uncompleted contracts	271,801.42	
		321,796.65
July 1, 1891, balance available		20,502.30
Amount (estimated) required for completion of existing project		1,980,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix E 5.)

6. *Removing obstructions in East River and Hell Gate, New York.*—Hell Gate is the worst obstruction in the narrow strait connecting Long Island Sound with New York Harbor, known as the East River.

At this point the channel turns at right angles around Halletts Point, opposite the mouth of the Harlem River, and the current runs with a velocity varying at different stages of the tide from 3 to 10 miles an hour over or around Way Reef, Pot Rock, Shell Drake, Frying Pan, Halletts Point, Negro Point, Holmes Rock, Hogs Back, Heel Tap, Flood Rock, Hen and Chickens, Gridiron, Mill Rocks, the Negro Heads, Rhinelander Reef, and Bread and Cheese.

Besides these most serious obstructions there are many other rocks and reefs in the East River, especially those off the Battery, off Thirty-third Street, Charlotte Rock, Shell Reef, off Tenth Street, and Middle Ground, off Sunken Meadows, which are dangerous to its crowded navigation, and which ought to be removed.

Originally the channel of East River and Hell Gate contained many large and dangerous rocky obstructions to navigation.

The depth over Diamond Reef at mean low water was 17½ feet; over Coenties Reef, 14.3 feet; over Frying Pan, 11 feet; over Pot Rock, 20 feet; over Heel Tap, 12.1 feet, and over reef at North Brothers Island, 16 feet. Halletts Point projected from the shore at Astoria under water 325 feet to the contour of 26 feet at mean low water and embraced an area of about 3 acres. The Middle Reef, with an area of about 9 acres, lay in the middle of the channels at Hell Gate. It had a small backbone projecting above high water, called Flood Rock, upon which vessels were stranded when driven there by the ebb currents which swept directly over the rock.

The project originally adopted in 1867 provided for the removal of the rocks and reefs that lay directly in the channel at Hell Gate to a depth of 26 feet at mean low water, and for the building of sea walls and dikes upon others that lay near the edge of the channel. The cost of the project was estimated at $8,692,645.15 (Annual Report Chief of Engineers, 1868, page 741); this estimate was revised in 1870 and the cost placed at $4,689,820. The estimate was again revised in 1874 to include the removal of Diamond and Coenties reefs, and the total cost fixed at $5,139,120 (Annual Report Chief of Engineers, 1874, Part II, page 164). It provided for the removal at Hell Gate to a depth of 26 feet mean low water, of the reef at Halletts Point, Way Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Negro Point, and Flood Rock, including the Gridiron, Hen and Chickens, and Negro Heads, and for the construction of a dike to connect the Mill Rocks, and sea walls upon Hogs Back and Holmes Rock; and in other parts of the East River for the removal of Diamond and North Brothers Island reefs to a depth of 26 feet; Coenties Reef to a depth of 25½ feet; and the small rocks known as Scaly Rock, Blackwell Rock, and rock off Woolsey's bath house.

The project was enlarged in 1884 to include the removal of Pilgrim Rock, off Nineteenth street, and again in 1889 to include the removal of the reef off Diamond Reef, reef off Thirty-third street, and Charlotte Rock, northwest of entrance to Newtown Creek, and in 1890 to include the removal of Shell Reef off Ninth street, and Middle Ground opposite Sunken Meadows.

The amount expended up to the close of the fiscal year ending June 30, 1890, inclusive of outstanding liabilities, was $3,814,644.84. At that date Halletts Point, covering 3 acres, Way Reef, Shell Drake, Diamond Reef, North Brother's Island Reef, Coenties Reef, and Scaly

Rock had been removed to the depth contemplated in the project. Pilgrim Rock had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet at mean low water, respectively; the reef off Thirty-third street had been lowered from a least depth of 7.1 feet to a least depth of 19 feet, and 1,744 tons of rock had been removed from reef off Diamond Reef. Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet, and 132,464 tons of the débris had been removed; the Negro Heads and Hen and Chickens had been reduced to 18 feet, mean low water, and a new 18 foot channel, 500 feet wide, had been opened across the reef Sea walls had been built by the Government to connect Great and Little Mill Rocks, and by the city authorities on Bread and Cheese.

These results have been of the greatest value to navigation.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $100,064.30, and was applied in removing, by hired labor, 24,040 tons of broken stone from Flood Rock, by the use of the two United States engineer dredges, in removing 2,737 tons of rock by use of the United States steam drill scow from reef off Diamond Reef, and in removing under contract 3,435½ cubic yards of material and 960½ tons of bowlders from Shell Reef off Ninth street.

July 1, 1890, balance unexpended		$95,286.28
Amount appropriated by act approved September 19, 1890		200,000.00
		295,286.28
June 30, 1891, amount expended during fiscal year		91,708.39
July 1, 1891, balance unexpended		203,577.89
July 1, 1891, outstanding liabilities	$8,355.91	
July 1, 1891, amount covered by uncompleted contracts	55,528.57	
		63,884.48
July 1, 1891, balance available		139,693.41
Amount (estimated) required for completion of existing project		1,038,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix E 6.)

7. *Newtown Creek, New York.*—This is a tidal stream about 4 miles long, running through the eastern part of Brooklyn, and emptying into the East River opposite Thirty-fourth street, New York City.

It had formerly a depth of 12½ feet, mean low water, at the mouth, gradually decreasing to 4 feet at the head.

The original project for its improvement, adopted in 1880, but modified in 1883, provided for a channel 200 feet wide and 21 to 22 feet deep, mean low water, extending from the mouth up to Vernon Avenue Bridge, and from that point up to the head of navigation on both branches, a channel decreasing from 175 feet to 100 feet in width, and from 18 feet to 10 feet in depth, at an estimated cost of $255,569.

The amount expended up to the close of the fiscal year ending June 30, 1890, inclusive of outstanding liabilities, was $101,965.52.

At that date the channel below Vernon Avenue Bridge was 60 feet wide and 21 feet deep, mean low water; from Vernon Avenue Bridge to Central Oil Works the channel was 80 feet wide and 18 feet deep, mean low water, and the shoal opposite Queens County Oil Works had

been removed to a depth of 10 feet, mean low water. At the head of navigation both branches had shoaled 3½ feet, approximately, reducing the depth in the channels there to 6½ feet, mean low water. The intermediate section had slightly deepened, though no work had ever been done there.

The amount expended during the fiscal year ending June 30, 1891, was $35,799.05, inclusive of outstanding liabilities, and was applied in dredging 121,908 cubic yards of material from various reaches of the creek. At the close of the year the channel from the entrance to Vernon Avenue Bridge is 175 feet wide at the entrance and 150 feet wide near the bridge, and is 21 feet deep. The channel from Vernon Avenue Bridge to Central Oil Works is 80 feet wide and 18 feet deep; from Central Oil Works to Queens County Oil Works, 50 feet wide and 15 feet deep; from Queens County Oil Works to Penny Bridge, 50 feet wide and 12 feet deep. The channel from Maspeth avenue to Metropolitan avenue is 100 feet wide and 10 feet deep, mean low water. In the English Kills branch the channel is 100 feet wide and 10 feet deep from Nichols' Chemical Works to a point 700 feet to the eastward.

The existing channel is not adequate in width or depth to the demands of commerce, and the adopted project for improvement should be completed as early as practicable by methods which will carry the improvement progressively from the mouth to the head of navigation.

From information gained in regard to the necessities of this stream, it is believed that the depth from the entrance to Vernon Avenue Bridge may be properly increased to 23 feet, mean low water; thence to Penny Bridge to 20 feet, and thence to Metropolitan avenue, 12 feet.

July 1, 1890, balance unexpended		$7,272.98
Amount appropriated by act approved September 19, 1890		35,000.00
		42,272.98
June 30, 1891, amount expended during fiscal year		28,667.04
July 1, 1891, balance unexpended		13,605.94
July 1, 1891, outstanding liabilities	$7,132.01	
July 1, 1891, amount covered by uncompleted contracts	4,094.96	
		11,226.97
July 1, 1891, balance available		2,378.97
Amount (estimated) required for completion of existing project		113,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix E 7.)

8. *Buttermilk Channel, New York Harbor.*—Buttermilk Channel lies between the city of Brooklyn, N. Y., and Governor Island, New York Harbor, and is obstructed at its upper end, where it joins the East River, by a shoal, over which there was formerly a least depth of 9½ feet at mean low water. The crest of this shoal lay about 800 feet distant from the line of the Brooklyn wharves.

The original project of improvement adopted in 1881 provided for the removal to a depth of 26 feet, mean low water, of such parts of the shoal as came within 850 feet of the Brooklyn wharves, which would take off the crest of the shoal and give elsewhere a depth of not less than 15 feet, mean low water.

The estimated cost of the improvement was $210,000. In view of the increasing importance of the wharves on the Brooklyn shores and the difficulty experienced by deep-draft vessels in getting up to them by

reason of this shoal, the project of improvement was modified in 1885 so as to provide for the removal of the entire shoal to a depth of 26 feet, mean low water, at an estimated additional cost of $150,000, making the total estimated cost of the project $360,000.

The amount expended up to the close of the fiscal year ending June 30, 1890, inclusive of outstanding liabilities, was $281,612.15. At that time the southern end of the shoal had been lowered to 26 feet, mean low water, and a north and south cut 450 feet wide had been excavated along the whole of the shoal.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $48,946.30, and was applied in dredging 189,540 cubic yards of material from the shoal. The shoal has been, it is believed, entirely removed to a depth of 26 feet, mean low water. There is a balance under the contract of $5,000 available for application towards the further improvement of Buttermilk Channel by excavation from the shoal opposite Red Hook Point.

This latter shoal containing, it is estimated, 1,681,439 cubic yards, approximately, obstructs the southern entrance to the channel, but its removal was not included in the project for the removal of Buttermilk Shoal now completed.

It is important that the Red Hook Shoal should be removed so as to give along the Atlantic Basin the full depth of 26 feet, mean low water, which is projected for other points in the harbor, and to facilitate communication with the East River through the improved Buttermilk Channel.

July 1, 1890, balance unexpended		$73,370.04
June 30, 1891, amount expended during fiscal year		36,474.81
July 1, 1891, balance unexpended		36,895.23
July 1, 1891, outstanding liabilities	$12,471.79	
July 1, 1891, amount covered by uncompleted contracts	19,288.24	
		31,760.03
July 1, 1891, balance available		5,135.20
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix E 8.)

9. *Gowanus Bay, New York.*—Gowanus Bay is a part of New York Harbor, lying at the mouth of Gowanus Creek, in the southwestern part of the city of Brooklyn.

The depth of water in the channel of Gowanus Creek and Bay was originally only from 7 to 12 feet at mean low water, which was wholly insufficient for the passage of vessels employed in the commerce of the district.

The plan of improvement adopted in 1881 provided for a depth of 18 feet to the channels in the bay leading up to the mouth of the creek on both the north and south sides, and for carrying the improvement with the same depth up the creek to Hamilton Avenue Bridge, a distance of 1 mile.

The channel widths were to be 200 feet, except for the last few hundred feet up to the bridge, in which distance the width would gradually decrease.

The estimated cost of this improvement was $192,564.90.

The project of 1881 was modified in 1888 by increasing the depth to 21 feet, and the width to 400 feet, while to facilitate the handling of vessels in the contracted space near the mouth of Gowanus Creek more

room was provided for by cutting away the angle on the south side at an estimated total cost of $600,000.

The amount expended to the close of the fiscal year ending June 30, 1890, inclusive of outstanding liabilities, was $107,430.42. At that date the Red Hook and Gowanus Creek Channels, under the modified project of 1888, had been carried 75 feet wide and from 19 to 21 feet deep, mean low water, from the entrance to Erie Basin to the foot of Percival street, Brooklyn, and the triangular slip at the foot of Bryant street had been dredged to 21 feet, mean low water.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $52,216.37, and was applied in removing 267,544 cubic yards of material from the Red Hook and Gowanus Creek Channel. At that date this channel, from the entrance to Erie Basin to Twenty-eighth street, was 150 feet wide and 21 feet deep, mean low water, thence to the foot of Percival street, 100 feet wide and 21 feet deep, and the triangular slips at the foot of Court, Bryant, and Smith streets had been dredged to 21 feet.

The improvement of Bay Ridge Channel extending from Twenty-eighth street south and west to Sixtieth street, south shore, which, under the project of 1881 was suspended in 1884, was resumed in May, 1891, under a specific appropriation of $100,000 contained in the river and harbor act of September 19, 1890, which provided for a channel 400 feet wide and 21 feet deep. At the close of the fiscal year, June 30, 1891, the sum of $18,450.15, inclusive of outstanding liabilities, had been expended under contract. At that date 84,815 cubic yards had been removed, and the improved channel, beginning at Forty-second street, had been carried north a distance of 1,800 feet, 30 feet wide and 21 feet deep, and south a distance of 650 feet, 35 feet wide and 21 feet deep.

July 1, 1890, balance unexpended		$29,711.41
Amount appropriated by act approved September 19, 1890		160,000.00
		189,711.41
June 30, 1891, amount expended during fiscal year		53,653.31
July 1, 1891, balance unexpended		136,058.10
July 1, 1891, outstanding liabilities	$17,013.21	
July 1, 1891, amount covered by uncompleted contracts	109,529.19	
		126,542.40
July 1, 1891, balance available		9,515.70
Amount (estimated) required for completion of existing project		480,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix E 9.)

10. *New York Harbor, New York.*—Before the improvement of the main entrance into New York Harbor was undertaken by the United States, the least depth in mid-channel on the bar was 23.7 feet at mean low water, and the same depth could be carried across three other shoals between the bar and deep water in the harbor.

A large proportion of the vast commerce of the port which is carried on in vessels of great draft could only cross these shoals at or near high water.

The project for the improvement of Gedney Channel was approved by the Secretary of War in December, 1884, and its extension to cover the whole of the main entrance to the harbor received his approval De-

cember 27, 1886. It provides for dredging a channel 1,000 feet wide and 30 feet deep at mean low water, from deep water below the Narrows through the Main Ship Channel and Gedney Channel to deep water outside the bar; maintaining this channel, should it be necessary, either by periodical dredging or by contracting the entrance by the construction of a dike running across the shoals from the Coney Island side, with suitable protection for the head of Sandy Hook to prevent its being scoured away by the increased current.

The estimated cost of obtaining the dredged channel is $1,490,000 for dredging 4,300,000 cubic yards. and the entire cost of the improvement should the contraction works prove to be necessary is estimated at between $5,000,000 and $6,000,000.

Under this project an extended survey of the lower bay has been made, on which the method of improvement was based.

The total amount expended to June 30, 1890, inclusive of outstanding liabilities, was $1,135,696.80.

At that time Gedney Channel and Bayside Channel (east and west) were practically completed. having a depth of 30 feet, mean low water, for the full projected width of 1,000 feet. The Main Ship Channel, west of Flynn Knoll and south of Buoy 12, had a depth of 30 feet, mean low water, for a width varying from 500 to 800 feet, and a depth of 28 feet for a width of 800 feet throughout.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $309,705.74.

The contracts with the Joseph Edwards Dredging Company dated March 18, 1890, for the removal of 425, 000 cubic yards, and August 13, 1890, for the removal of 530,000 cubic yards, were completed. The contract with the Joseph Edwards Dredging Company, dated February 16, 1891, for the removal of 500,000 cubic yards has progressed satisfactorily, and at the close of the fiscal year 284,497 cubic yards had been removed. The aggregate number of yards removed by the contractors during the year was 1,008,097 cubic yards all from the Main Ship Channel, extending from Buoy No. 10, Lower Bay, northward to deep water below the Narrows. As a result of this work a survey, made in December, 1890, showed that the Main Ship Channel from Buoy No. 10 north to Buoy No. 12 had then a depth of 30 feet, mean low water, for a width varying from 500 to 800 feet, and a depth of 28 feet for a width of 1,000 feet throughout. From Buoy No. 12 northward to deep water below the Narrows there was then a 30-foot channel not previously improved, 400 feet wide, and a 28-foot channel 1,000 feet wide. The 30-foot channel had a least width of 400 feet from deep water below Buoy No. 10, Lower Bay, to deep water below the Narrows, a distance of 22,000 feet, and there was a 28-foot channel, 1,000 feet wide, throughout the entire length of this reach. Detailed surveys of the entire channel from the Narrows to the sea are in progress. The results which have been plotted for Gedney Channel only show that the minimum depth of 30 feet in a channel width of 1,000 feet which existed there at the last survey, January, 1890, has not changed.

The riprap sea wall authorized by the Chief of Engineers February 20, 1890, for the protection of the north shore of Sandy Hook was built from jetty No. 4 to jetty No. 10, a distance of 1,800 feet, by November 1, 1890, 5,784 tons of large stone were put in place. This wall has served to give the desired protection.

A contract was made March 26, 1891, for 5,000 tons of large stone for additional revetment, and to provide for settlement along the wall. At the close of the year 2,511 tons had been delivered and placed in

position and the sea wall had been extended 375 feet eastward from jetty No. 4 to jetty No. 1, and 200 feet westward from jetty No. 10 towards jetty No. 11.

July 1, 1890, balance unexpended		$233,516.85
Amount appropriated by act approved September 19, 1890		160,000.00
		393,516.85
June 30, 1891, amount expended during fiscal year		273,400.28
July 1, 1891, balance unexpended		120,116.57
July 1, 1891, outstanding liabilities	$36,305.46	
July 1, 1891, amount covered by uncompleted contracts	52,924.70	
		89,230.16
July 1, 1891, balance available		30,886.41
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		250,000.00

(See Appendix E 10.)

11. *Raritan Bay, New Jersey.*—Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island.

The channel undergoing improvement lies to the southeast of Seguine Point, on the south shore of Staten Island. At the time of the original survey, August, 1880, the least depth on the shoal lying between the 21-foot curve at Seguine Point and the 21-foot curve at the head of the bay was 14½ feet, mean low water. The project of improvement, based upon the survey, provided for a channel across the shoal 300 feet wide and 21 feet deep, mean low water, at an estimated cost of $126,500.

The project was modified in 1885, extending the improvement by providing for a channel of equal width and depth over the shoals in the vicinity of Ward Point, Staten Island, where the original depth was 18 feet, mean low water, so as to give a navigable channel 21 feet deep, mean low water, up to Perth Amboy, and for a channel 300 feet wide and 15 feet deep, mean low water, from Great Beds Light to South Amboy, where the original depth was 12½ feet, mean low water, at an estimated cost of $240,500 for the entire work from the beginning, which estimate was again increased in 1888 to $246,500, to provide for the removal of deposits which had taken place in the interval of 3 years.

The channel from deep water at the head of Raritan Bay past Seguine Point to Perth Amboy exceeds 5 miles in length, is crooked, and is subject to constant shoalings. As the amount appropriated any one year for the execution of the project has been much less than the estimated cost of the improvement and as the channel excavated under each appropriation has been impaired by shoaling in a greater or less degree before work would be resumed under the succeeding appropriations, the original estimates for this improvement have little value and can not be used for determining the amount required for completing the project at this date. The estimated cost for completing the project, if all the required money could be made available at this time, is $175,375.

The amount expended upon the modified project of 1885 up to the close of the fiscal year ending June 30, 1890, inclusive of outstanding liabilities, was $180,560.28. At that date the channel was 300 feet wide and 21 feet deep, mean low water, from Perth Amboy to the bend at Great Beds Light, and 300 feet wide and 20 feet deep, mean low water,

across the crest of the shoal in the channel leading from the bend towards Seguine Point. The channel eastward of Seguine Point had a width of 100 feet and a depth of 21 feet, mean low water, while the channel from Great Beds Light to South Amboy was from 70 to 80 feet wide and 15 feet deep, mean low water.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $17,119.74, and was applied in removing 82,035 cubic yards of material from the channel leading from Great Beds Light to South Amboy, resulting in a channel 170 feet wide and 15 feet deep, mean low water. Work will begin on the Seguine Point channel about July 15.

July 1, 1890, balance unexpended		$1,939.72
Amount appropriated by act approved September 19, 1890		40,000.00
		41,939.72
June 30, 1891, amount expended during fiscal year		9,889 48
July 1, 1891, balance unexpended		32,050.24
July 1, 1891, outstanding liabilities	$7,230.26	
July 1, 1891, amount covered by uncompleted contracts	18,160.11	
		25,390.37
July 1, 1891, balance available		6,659.87
Amount (estimated) required for completion of existing project		135,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix E 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—The schooner *Salamander* was removed from Raritan Bay, New Jersey, January 21, 1891, under contract with John F. Baxter, at a cost of $495.

The schooner *Francis E. Hallock* was removed from the outer shoal of the southern entrance of the harbor of New York, near the eastern entrance to East Channel, April 23, 1891, under contract with the Merritt Coast Wrecking Company, at a cost of $1,500.

(See Appendix E 12.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Gillespie, and reports thereon submitted. It is his opinion, based upon the facts and reasons given, that these localities are not worthy of improvement. This opinion being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Buttermilk channel and Gowanus Bay channels in New York Harbor, New York, with a view of straightening the same by removing the shoals opposite the southeast side of Governor's Island, protecting the channels by a sea wall on Governor's Island, and to provide for the full width thereof a uniform depth of 26 feet at mean low water throughout these channels along the wharves of Brooklyn from a point opposite Wall street ferry to the foot of Bryant street, Brooklyn.*—Printed as House Ex. Doc. No. 26. (See also Appendix E 13.)

2. *Bay Ridge Channel, New York, with a view of removing the shoal and providing a uniform depth of 23 feet at mean low water, opposite the Bay Ridge shore, to the 23-foot curve in the New York Harbor.*—Printed as House Ex. Doc. No. 60. (See also Appendix E 14.)

3. *Champlin's Creek, in town of Islip, New York.*—Printed as House Ex. Doc. No. 66. (See also Appendix E 15.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Gillespie, and reports thereon submitted. It is his opinion, based upon the facts and reasons given, that these localities are worthy of improvement. This opinion being concurred in by me, Lieutenant-Colonel Gillespie was charged with and has completed their survey and submitted reports thereon:

1. *Hudson River at Cornwall from the Moodna River, otherwise known as Murderer's Creek, to the channel or deep water of the Hudson River, New York.*—Lieutenant-Colonel Gillespie stated in his report on the preliminary examination that this locality was worthy of improvement in view of the probable construction of a draw-opening in the railroad bridge. Since the survey was ordered, however, the action brought against the railroad company for obstructing navigation by the bridge was decided in favor of the defendant, the effect of the verdict being that Muderer Creek is not a navigable water-way of the United States. In view of these facts Lieutenant-Colonel Gillespie does not recommend that appropriation be made of the amount, $10,000, estimated as the cost of forming a channel 60 feet wide and 9 feet deep at mean low water from the bridge to the deep water of Hudson River. (See Appendix E 16.)

2. *Bronx River, New York.*—The improvement proposed contemplates widening and deepening the existing channel so as to afford a navigable channel 4 feet deep at mean low water, and 100 feet wide from the head of the estuary at Strain place to Barlow street, 60 feet wide to Dongan street, and 50 feet wide to West Farms below the Bronx Company's Dye Works, at a total estimated cost of $85,985. (See Appendix E 17.)

3. *Westchester Creek, Westchester and New York Counties, New York.*—The improvement proposed contemplates dredging a channel 8 feet deep at mean low water and 100 feet wide across the estuary, thence 80 feet wide to a point about 1,000 feet above Scriven's dock, and thence 60 feet wide to the head of navigation, at a total estimated cost of $27,500. (See Appendix E 18.)

The required preliminary examination *from Main Channel from Jamaica Bay easterly to Lony Beach Inlet, New York, for canal*, was made by the local engineer in charge, Lieutenant-Colonel Gillespie, and report thereon submitted. It is his opinion, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Lieutenant-Colonel Gillespie was charged with its survey, the report on which will be submitted when received.

IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHWESTERN SHORE OF LONG ISLAND AND NEAR STATEN ISLAND, NEW YORK, AND IN NORTHEASTERN NEW JERSEY.

Officer in charge, Capt. Thos. L. Casey, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Sumpawanus Inlet, New York.*—The channel depth at the time of the adoption of the project varied from 5 feet in the bay at mean low water to 2 feet at the wharf at the mouth of the creek, a distance of a little over half a mile.

The project for the improvement of this inlet, known locally as Sumpawanus Creek, adopted in 1880, provided for dredging a channel about 4,500 feet long and from 100 to 150 feet wide and 5 feet deep at mean low water, beginning at the 5-foot curve in the Great South Bay and extending up to the town of Babylon, Long Island.

The amount expended under this project to June 30, 1890, was $7,000.

With this amount a channel 75 feet wide and 5 feet deep from the steamboat wharf to a point 750 feet below it was dredged, besides dredging two cuts, each 25 feet wide, alongside the wharf.

Outside of the cuts so made and extending to the 5-foot curve in the bay a shoal was left, on which the depth was only $4\frac{3}{4}$ feet.

An examination made in 1886 showed that since the last dredging was done, in 1883, both the cut and the flat outside had shoaled from 6 inches to 1 foot, the depth in the cut being about 5 feet, while on the flat it was from 4 to $4\frac{1}{2}$ feet. This was to have been anticipated, as appears by the preliminary report made by General Newton. The 5-foot curve in the bay was about 1,500 feet from the steamboat wharf, but inside this curve, for about 750 feet towards the wharf, lay the flat.

The commerce of Sumpawanus Creek is essentially that of Babylon, a small town of from 3,000 to 5,000 inhabitants, 1 mile above the mouth of the creek, depending almost entirely upon the summer trade of the hotels and cottages along the north shore of Great South Bay and on Fire Island Beach.

The commerce of Babylon by water has been decreasing, apparently because the Long Island Railroad has taken away the seagoing business. Babylon itself has improved, and has become a fashionable summer resort. At present its commerce by sea is carried on by 3 passenger steamboats, drawing from 4 to 5 feet, and running in summer to Fire Island Beach; 3 schooners drawing from 5 to $5\frac{1}{2}$ feet, carrying brick, lime, lumber, and other heavy freight to Babylon the year round; 100 sloops and pleasure boats, drawing from 1 to 2 feet of water, taking out sailing and fishing parties during the summer, of which 7 or 8 remain in use during the winter fishing and taking oysters and clams to Patchogue, Sayville, and New York.

There were no expenditures on account of this work during the fiscal year ending June 30, 1891, there being no funds available.

Amount (estimated) required for completion of existing project.....	$16,115.00
Amount that can be profitably expended in fiscal year ending June 30,1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 1.)

2. *Canarsie Bay, New York.*—The original condition of the channel leading to Canarsie answered to a depth of $4\frac{1}{2}$ feet mean low water.

The original project, adopted in 1879, provides for obtaining a navigable channel 6 feet deep at mean low water from Canarsie Landing to the deep water in Jamaica Bay, by means of diking and the formation of a tidal basin. In the Annual Report of the Chief of Engineers, 1880, Part 1, page 574, General Newton expressed a doubt as to adequate appropriations being made for carrying out the authorized project, and suggested that dredging be tried as an expedient.

The amount expended to the close of the fiscal year ending June 30, 1890, was $42,485.99.

With this amount two pile dikes have been built, one on the north side of the outer end of the channel, the other on the south side, their lengths being 1,058 feet and 820 feet, respectively; the channel dredged to a depth of 6 feet mean low water, and width of from 50 to 125 feet from

Canarsie Landing to deep water in Jamaica Bay, besides several minor improvements not contemplated in the original project.

The expenditures during the fiscal year ending June 30, 1891, amount to $202.37, for surveying and office expenses.

An appropriation of $5,000 was made in the act of September 19, 1890, and a project for its expenditure in dredging the channel to the full dimensions required by the project was approved October 20, 1890. The work was advertised February 3, 1891. Bids were opened March 10, and a contract entered into March 20, 1891.

Work under the contract will be begun upon the completion of dredging at Shoal Harbor and Compton Creek, this work having also been included under the same contract, and is now being prosecuted with fair prospect of completion during the month of July, 1891.

The commerce of Canarsie Bay is reported for the calendar year 1890 to be 50,898 tons, against 26,262 tons reported for 1889.

July 1, 1890, balance unexpended	$514.01
Amount appropriated by act approved September 19, 1890	5,000.00
	5,514.01
June 30, 1891, amount expended during fiscal year	202.37
July 1, 1891, balance unexpended	5,311.64
July 1, 1891, amount covered by uncompleted contracts	3,185.00
July 1, 1891, balance available	2,126.64
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 2.)

3. *Sheepshead Bay, New York.*—The original condition of the navigable channel was, for the entrance a depth of a little over 2 feet at mean low water, and for the interior channel not less than 4 feet, except at two narrow bulkheads across said channel.

The originally adopted project (1879) was to deepen the entrance by means of converging jetties, and to improve the interior channel by longitudinal dikes, so placed as in some instances to form tidal reservoirs for the scour of the channel. The project was revised in 1881, and provides for excavating a channel at the outlet 100 feet wide and 6 feet deep at mean low water, to connect the bay with Dead Horse Inlet, and to dredge the interior channel; this was modified in February, 1889, the modified project contemplating a channel 5,350 feet long, 60 feet wide, and 5½ feet deep, mean low water, from the town of Sheepshead to within 1,080 feet of Dead Horse Inlet, cut to connect with the channel of similar width and depth already existing at that point.

The amount expended on this project to the end of the fiscal year ending June 30, 1890, was $25,236.52.

With this amount a channel had been dredged 100 feet wide and 6 feet deep at mean low water, connecting the east end of the bay with Dead Horse Inlet, and the interior channel dredged 60 feet wide and 5½ feet deep at mean low water, for a distance of 3,400 feet, from the town of Sheepshead toward Dead Horse Inlet. The first mentioned channel, from a survey made in 1887, was observed to have not maintained itself, having contracted to a width of 60 feet with an average depth of 5½ feet mean low water; the condition of the more recently dredged interior channel, however, has been found by a recent examination to be highly satisfactory.

The expenditures for the fiscal year ending June 30, 1891, amount to $497.74, for office expenses.

July 1, 1890, balance unexpended	$713.48
June 30, 1891, amount expended during fiscal year	497.74
July 1, 1891, balance unexpended	215.74
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	8,200.00

(See Appendix F 3.)

4. *Arthur Kill, New York and New Jersey.*—A history of this improvement, which originated by special resolution of the Committee of Commerce in the Senate, is given in the Annual Report of the Chief of Engineers for 1889, part 1, page 819.

The improvement consists in the removal of a point of land near and to the south of the Staten Island Bridge, for the purpose of straightening the channel, in order that the currents may be directed more truly in a direction perpendicular to the draw span of the bridge thus facilitating the passage of long tows.

A statement of condemnation proceedings for acquiring to the United States the land needed for this improvement will be found in the Annual Report of the Chief of Engineers for 1890, part 1, page 843.

The total amount expended on this improvement to June 30, 1890, was $3,135.50.

This expenditure includes the part purchase of a tugboat, and the expenses incurred in the condemnation proceedings above alluded to, as well as certain administrative expenses.

An appropriation of $7,000 was made in the act of September 19, 1890, and a project for its expenditure was approved October 4, 1890. This project contemplates the removal of the land forming "Steep Point," by successive parallel cuts, until the appropriation is exhausted. Sealed proposals for doing the work were invited by advertisement dated February 3, 1891. Bids were opened March 10, and a contract entered into March 21 with the Atlantic Dredging Company, the lowest bidder, at 24½ cents per cubic yard. Operations were begun May 29, and finished June 25, the amount of material removed being 22,000 cubic yards, giving an additional width of 60 feet to the already improved channel, with a depth of 13 feet at mean low water, the amount of land removed being one-half an acre.

The expenditures as shown for the present fiscal year amount to $7,205.09 Of this amount $6,815 was due for work performed under contract in the previous fiscal year, and reported in Annual Report of the Chief of Engineers, 1890, part 1, page 844.

July 1, 1890, balance unexpended	$6,864.50
Amount appropriated by act approved September 19, 1890	7,000.00
	13,864.50
June 30, 1891, amount expended during fiscal year	7,205.09
July 1, 1891, balance unexpended	6,659.41
July 1, 1891, outstanding liabilities	5,396.00
July 1, 1891, balance available	1,263.41
Amount (estimated) required for completion of existing project	9,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	9,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 4.)

5. *Channel between Staten Island and New Jersey.*—Before this improvement was undertaken by the United States there was a navigable channel having a minimum depth of 9.2 feet from the deep water in Newark Bay to Elizabethport.

The first project for the improvement of this channel was made in 1873. This provided for dredging it to a depth of 16 feet for a width of 150 feet at its shallowest part, and protecting the cut by parallel dikes. The estimated cost of this was $443,210. Fifty thousand dollars of this amount, appropriated in 1874, was spent in 1874–'75 in the construction of 2,237 feet of the south dike, opposite Elizabethport.

Great opposition being made to this plan by oystermen and towboatmen, it was decided to modify it. and the project was therefore changed in 1880 so as to dredge a channel 400 feet wide and 13 feet deep over the middle 00 feet of its width, leaving it but 12 feet deep over the remaining widths of 100 feet on each side. The estimated cost of this work was $125,705. In addition to this it was proposed, should it be found necessary, to build four detached dikes along the line of the channel, two on the north and two on the south side, the estimated cost of which was $60,000, bringing the total estimated cost of the proposed improvement up to $185,705. Subsequently it was decided to give the channel 13 feet depth for its full width of 400 feet.

A modification of this project, having in view the abandonment of the dikes, was submitted May 9, 1889, and was approved by Department letter dated May 15, and a further modification, calling for a uniform channel depth of 14 feet at mean low water over the entire width of 400 feet, was approved October 20, 1890.

The amount expended to June 30, 1890, was $183,627.15.

With this amount 2,237 feet of dike was built, the channel given depths of from 13 to 20.7 feet mean low water throughout its length, and with widths of from 250 to 350 feet, the narrowest portion being in the vicinity of the Corner Stake Light.

The expenditures during the past fiscal year amount to $6,983.91.

A project for the expenditure of the appropriation of $15,000 in the act of September 19, 1890, was approved October 20, 1890. Sealed proposals for doing the work by dredging were invited by advertisement dated February 3, 1891. Bids were opened March 10, and a contract entered into March 23, 1891, with Thomas H. Benton, at 26 cents per cubic yard. Work under this contract was begun April 20, and completed June 29, 44,820 cubic yards of material having been removed. Under this contract the channel has been increased in width by 100 feet for a distance of 3,000 feet, the depth being from 13 to 14 feet at mean low water.

This dredging has resulted in considerable improvement of the channel in regard to width, which, because of the sharp turn at the Corner Stake Light, should be as great as is consistent with the maintaining power of the current.

The reported increase in the commerce making use of this channel for the calendar year is 348,543 tons.

July 1, 1890, balance unexpended	$372.85
Amount appropriated by act approved September 19, 1890	15,000.00
	15,372.85
June 30, 1891, amount expended during fiscal year	6,983.91
July 1, 1891, balance unexpended	8,388.94
July 1, 1891, outstanding liabilities	5,891.32
July 1, 1891, balance available	2,497.62

Amount (estimated) required for completion of existing project.....	$61,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 5.)

6. *Passaic River, New Jersey.*—This river is being improved under two separate projects, the first applying to the river below Centre Street Bridge, Newark, to and beyond the shoals in Newark Bay, a distance of 7⅝ miles, and the second to the upper course of the river from Centre Street Bridge as far as Passaic, a distance of 8 miles.

a. Below Newark.—The lower portion of the river, from Centre Street Bridge to Newark Bay, was first surveyed by the Engineer Department, in 1879. The greatest depth in the channel, at a point above the Elbow Beacon, was only 7.1 feet, and in many places the greatest depth was 7.5 feet at mean low water.

A project was adopted, based on this survey, providing for obtaining by diking and dredging a channel 200 feet wide and 10 feet deep at mean low water from the Centre Street Bridge to Newark Bay, at a cost of $232,875.

This project was modified in 1884, pursuant to the river and harbor act of that year, providing for extending the dike at the mouth of the river into the bay, a distance of 12,000 feet, and for dredging a channel across the shoal in Newark Bay, 200 feet wide and 10 feet deep at mean low water, increasing the original estimate to $353,875.

The amount expended to June 30, 1890 was $198,257.27.

With this amount 6,205 feet of dike was built, the channel through the shoal in the bay, as also the channel up the river to, and 1,423 feet beyond the Newark and New York Railroad Bridge, dredged to the full dimensions as required by the adopted project. Thence a section 1,150 feet up stream was redredged and given a width of 180 feet, and from this point to Lister Dock, Newark, the river was regulated to a width of 100 feet, with a uniform depth of 10 feet at mean low water throughout. A recent survey of the portions of the river dredged by the appropriation of August 11, 1888, shows that the depths have been maintained unexpectedly well during the past winter.

One thousand nine hundred and twenty-eight dollars and fifty-eight cents have been expended during the fiscal year ending June 30, 1891, in surveying the portions of the river dredged in 1889, and in necessary office expenses.

Under the appropriation of $40,000, made in the act of September 19, 1890, a contract was entered into March 21, 1891, with R. G. Packard, for the removal by dredging of 110,000 cubic yards of material at 30 cents per cubic yard. Work had not been begun by the contractor at the close of the fiscal year, but assurance had been given of its commencement early in July.

The commerce of this river was valued in 1889 at $44,722,750, and for 1890 it is given at $49,195,025.

July 1, 1890, balance unexpended.....	$1,241.73
Amount appropriated by act approved September, 19, 1890.....	40,000.00
	41,241.73
June 30, 1891, amount expended during fiscal year	1,928.58
July 1, 1891, balance unexpended.....	39,313.15
July 1, 1891, amount covered by uncompleted contracts.....	33,000.00
July 1, 1891, balance available.....	6,313.15

{Amount (estimated) required for completion of existing project..... $114,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Above Newark.—Before its improvement was undertaken, the upper part of the river had a navigable 6-foot channel except at Middle, Belleville, Rutherford Park, and Holzman Bars, where the depths were 4.5 feet, 3.9 feet, 3 feet, and 3.5 feet, respectively.

The project of improvement was adopted in 1872 and provided for a channel across and above the shoals from 7½ to 6 feet deep mean low water, and from 200 to 50 feet wide, to be obtained by dredging and dishing, at a cost of $123,924. It was modified in 1885 by extending the channel below Middle Bar, 1,500 feet to the Erie Railroad Bridge, increasing the estimate to $129,000, which was further increased in 1886 to $133,762. The deposit of material from freshets, together with the difficult and costly nature of the dredging, prompted a recommendation to increase this last estimate to $193,822, which was approved October 6, 1890.

The amount expended to June 30, 1890, was $129,702.28.

With this amount, channels of the required depth had been dredged from 60 to 75 feet wide, excepting for a distance of 1,500 feet above the Erie Railroad Bridge.

The expenditures during the fiscal year ending June 30, 1891, amount to $432.39, for office expenses.

No work of improvement has been done on the upper river during the fiscal year, though a contract was entered into on March 23, 1891, with Richard Parrott for the removal, by dredging, of 13,000 cubic yards, more or less, of material. Work under the above contract will be begun upon the completion of dredging in Elizabeth River, New Jersey, as both works were awarded the same contractor and are included under one contract.

The commerce, although by no means as extensive as that of the lower portion of the river, appears to be increasing rapidly; this was reported for the calendar year 1889 to be 315,437 tons, valued at $2,545,077.

July 1, 1890, balance unexpended		4,047.72
Amount appropriated by act approved September 19, 1890		5,100.00
June 30, 1891, amount expended during fiscal year		9,147.72
July 1, 1891, balance unexpended		432.39
July 1, 1891, amount covered by uncompleted contracts		8,715.33
July 1, 1891, balance available		4,550.00
		4,165.33
Amount (estimated) required for completion of existing project		54,972.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 6.)

7. *Elizabeth River, New Jersey.*—This stream, which is 2⅝ miles in length from its mouth to the head of navigation at Broad street, Elizabeth, has a width of from 50 to 90 feet, and before its improvement the wharves in the city could only be reached at high water by vessels drawing less than 4 feet; its commerce was estimated at 45,000 tons

annually. The range of the tide was about 4.7 feet at its mouth and 3.4 feet at Bridge street.

The project for the improvement was adopted in 1878, and provides for obtaining, by dredging, a channel 60 feet wide and 7 feet deep at high water from the mouth of the river to the head of navigation, at an estimated cost of $25,530; this was increased in 1882 to $43,160, the increase being due to advanced prices.

The amount expended under this project to June 30, 1890, was $27.000.

With this amount the channel had been dredged to the required depth to within 1,000 feet of Broad Street Bridge. The condition of the river has deteriorated since work was suspended. When last examined vessels drawing 5 feet could ascend the river to the head of the dredged channel at high tide. The commerce of the river is about 39,000 tons, but no substantial increase can be expected while the river remains in its present condition.

The city of Elizabeth has a population of about 33,000, and does an active commerce over two important lines of railroad, a considerable portion of which would take the water route to great advantage if adequate facilities existed.

An appropriation of $5,000 was made in the act of September 19, 1890, and a project for its expenditure in redredging the channel to the required depth was approved October 20, 1890. The work was advertised February 3, 1891. Bids were opened March 10, and a contract entered into March 23 with Richard Parrott for the removal of 7,000 cubic yards, more or less, of material. Work under the contract was begun June 29.

The expenditures during the fiscal year amount to $265, for office expenses.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	265.00
July 1, 1891, balance unexpended	4,735.00
July 1, 1891, amount covered by uncompleted contracts	3,850.00
July 1, 1891, balance available	885.00
Amount (estimated) required for completion of existing project	11,160.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	11,160.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 7.)

8. *Rahway River, New Jersey.*—In its original condition the Rahway River had a depth of 8 feet and more at mean high water from its mouth to Bricktown, $3\frac{5}{8}$ miles; 7 feet to Edgar Dock, $4\frac{1}{8}$ miles; 4.4 feet to Milton Avenue Bridge, $4\frac{3}{4}$ miles; and 4 feet to Main Street Bridge, 5 miles, in the town of Rahway. Its commerce was estimated at 120,000 tons, and three attempts had been made to establish a line of steamboats on the river, but had failed on account of the bad condition of the stream.

The original project for its improvement was adopted in 1878, and provided for dredging a channel 125 feet wide and 8 feet deep at high water from Bricktown to Milton Avenue Bridge, and 100 feet wide from that point to Main Street Bridge. The tide rises about 5 feet at the mouth and 4 feet at the head of navigation.

The amount expended on this improvement to June 30, 1890, was $37,000.

With the above amount the channel had been given a depth of 7 feet at mean high water, and width of from 100 to 50 feet, to within 550 feet of the head of navigation. It has, however, not proved permanent. The commerce of the river had not increased, though freight rates to Rahway had been materially reduced as a result of the improvement of the river.

There has been no appropriation for this work since 1882, and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

Amount (estimated) required for completion of existing project.....	$29,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	29,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 8.)

9. *Raritan River, New Jersey.*—Before its improvement by the United States the Raritan River had a depth of 8.5 feet at "The Stakes," 3 miles; of 6.5 feet at the "Middle Grounds," 4½ miles; of 7.5 feet at Whitehead's Sand Dock, 8½ miles. and between this point and New Brunswick, 12¼ miles above the mouth, the channel was obstructed by a number of rocky shoals with depths of from 8.4 to 6.9 feet at mean low water. The city of New Brunswick and the Delaware and Raritan Canal, which terminates here, together with extensive brick yards on the South River, did a large commerce on the stream, estimated in 1871 at 3,053,857 tons per annum.

The present project was adopted in 1874 and provides for obtaining by diking and dredging, and, where necessary, by drilling and blasting rock, a channel 200 feet wide and 10 feet deep, mean low water, from the mouth to New Brunswick at a cost of $2,093,662.05. It was modified in 1881, pursuant to the river and harbor act of that year, by adding to it the dredging of the South Channel, about 13,000 feet long, 100 feet wide, and 5½ feet deep at mean low water, from Kearney's Dock to Crab Island.

The amount expended to June 30, 1890, under this project was $510,-685.39.

The above amount was expended in the construction of certain dikes required by the project at "The Stakes" and "Middle Grounds," in dredging channels 200 feet wide and 12 feet deep at mean low water at these points, and in blasting and dredging a channel of the same dimensions across the rocky shoal at Whitehead's Sand Dock, and thence up the river with a width of 100 feet and depth of 10 feet to within a mile of New Brunswick. Under the two special allotments made for it in the acts of March 3, 1881, and August 2, 1882, the south channel was dredged to the required depth for a distance of 4,000 feet. These improvements have been of great benefit to navigation, permitting the large tows in use on the river to reach a point 1 mile below New Brunswick at all stages of the tide. The commerce of the river is reported for the calendar year 1890 to be 1,661,425 tons, against 1,651,464 tons for 1889.

The expenditures during the fiscal year amount to $23,521.19.

The progress made during the fiscal year has resulted in an additional length of 4,300 feet, bringing the 100-foot channel to within 2,800 feet of the canal lock; this includes a section of 570 feet at Fox's Gully, excavated during the preceding year, as detailed in my last annual report.

July 1, 1890, balance unexpended	$10,564.61
Amount appropriated by act approved September 19, 1890	50,000.00
	60,564.61
June 30, 1891, amount expended during fiscal year	23,521.19
July 1, 1891, balance unexpended	37,043.42
July 1, 1891, outstanding liabilities	2,474.72
July 1, 1891, balance available	34,568.70
Amount (estimated) required for completion of existing project	1,522,412.05
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 9.)

10. *South River, New Jersey.*—Before the improvement of this stream was undertaken by the United States the navigation of the lower $2\frac{1}{2}$ miles of its course had been abandoned and a canal dredged at private expense from a short distance below Washington to Sayreville on the Raritan River. In 1880, when the present project for improving the river was adopted, the mouth of this canal, on account of its faulty location, had shoaled to a depth of 4.6 feet at mean low water, and the best depth in the canal, some distance above, had decreased to 3.3 feet. Above Washington a depth of 2.7 feet existed to Bissett, $3\frac{5}{8}$ miles, and of 2.5 feet to Old Bridge, the head of navigation, $6\frac{1}{4}$ miles above the mouth of the canal at Sayreville.

The present project, adopted in 1880, provides for closing the river below the head of the canal, correcting the direction of the mouth of the latter, and obtaining by diking and dredging a depth of 8 feet, mean low water, to Washington, 6 feet to Bissett, and 4 feet to Old Bridge, straightening the channel at two points by cutting across the meadow; it was estimated to cost $194,695.

The amount expended under this project to June 30, 1890, was $64,026.42.

With this amount the direction of the mouth of the canal had been changed, the dikes below Washington completed, and a small amount of dredging done on a shoal above Washington. A shoal at the mouth of Washington Canal has been removed and a channel dredged 60 feet wide through the canal, and 50 feet wide across the shoal in the river below Washington. Vessels drawing 6 feet can reach Washington at mean low water.

The work during the fiscal year consisted in widening the approaches to the draw of the Raritan River Railroad Company's bridge, widening the channel at the bend below Washington, and removing the bar at Rourke Reach, by dredging, under contract dated March 24, 1891. Work was begun May 25, 1891, and carried on continuously to the close of the fiscal year, 8.842 cubic yards having been removed. The expenditures amount to $374 for office expenses and inspection.

The commerce of the river was reported for the calendar year 1889 to be 310,350 tons, and for the calendar year 1890 it is given as 364,154 tons.

July 1, 1890, balance unexpended	$1,973.58
Amount appropriated by act approved September 19, 1890	5,000.00
	6,973.58
June 30, 1891, amount expended during fiscal year	374.00
July 1, 1891, balance unexpended	6,599.58
July 1, 1891, amount covered by uncompleted contracts	4,665.00
July 1, 1891, balance available	1,934.58

Amount (estimated) required for completion of existing project $123,695.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 10.)

11. *Keyport Harbor, New Jersey.*—Keyport Harbor was originally accessible at low water only to vessels drawing less than 4 feet. Before its improvement was undertaken by the United States a 6-foot channel had been dredged at private expense, which had shoaled in 1872 to 5½ feet and in 1882 to 5 feet, the range of the tide being 4.7 feet. A large commerce was carried on, however, valued at $2,932,000.

The project for the improvement was adopted in 1873, and provided for dredging a channel 4,700 feet long, 8 feet deep at mean low water, and 200 feet wide from the steamboat dock to the 8 foot contour in Raritan Bay, at an estimated cost of $30,475. The revised estimate of 1884 was $40,475.

The amount expended on this improvement to the close of the fiscal year ending June 30, 1890, is $30,475.

With the above amount a channel had been dredged from the 8-foot depth in Raritan Bay to Keyport Wharf, a distance of 5,000 feet, with a width of 200 feet for the first 4,200 feet and 160 feet for the remainder.

There has been no appropriation for this work since 1882, and there have been no funds for expenditure since the fiscal year ending June 30, 1890.

The increase of the commerce of this improvement, as compared with that reported in 1890, is about 54,000 tons.

Amount (estimated) required for completion of existing project..... $10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 11.)

12. *Mattawan Creek, New Jersey.*—Before its improvement by the Government this small stream was obstructed at its entrance into Keyport Harbor by a mud flat, on which the best depth at the worst section was 3.1 feet at mean low water, though the 3-foot channel was too narrow and tortuous for use. Above this flat a good 4-foot channel existed to 1⅛ miles above the mouth, and thence to the steamboat dock at Mattawan 3.5 feet, shoaling to 1.8 feet at the freight dock 600 feet above and 1⅞ miles from the mouth. The range of the tide is 4.7 feet. Notwithstanding the above difficulties, it carried commerce valued in 1880 at $800,000. In 1885 the commerce of the creek was stated to be 130,000 tons, valued at $2,000,000; it has since increased to 187,850 tons, valued at $2,463,200.

The project for the improvement was adopted in 1881, and provides for dredging a channel 4 feet deep at mean low water and 100 feet wide from the mouth to Winkson Creek, and thence 75 feet wide to the railroad bridge at Mattawan, 250 feet above the freight dock, at an estimated cost of $33,120.

To June 30, 1890, the amount expended under this project was $21,000, with which a channel had been dredged, giving the required depth from the mouth to the freight dock at Mattawan, with widths varying from 100 to 30 feet.

There were no funds for the improvement of this stream from 1882 until September 19, 1890, at which date an appropriation of $2,500 was made.

No work of improvement has been done during the fiscal year ending

June 30, 1891, though a contract was entered into March 21, 1891, with the Atlantic Dredging Company, for the removal by dredging of 5,300 cubic yards, more or less, of material at 37½ cents per cubic yard, measured in scows. Work will be begun upon the completion of dredging in the Arthur Kill, as both works were awarded the same contractor and are included under one contract.

Amount appropriated by act approved September 19, 1890	$2,500.00
July 1, 1891, balance unexpended	2,500.00
July 1, 1891, amount covered by uncompleted contracts	1,987.50
July 1, 1891, balance available	512.50
Amount (estimated) required for completion of existing project	9,620.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	9,620.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F 12.)

13. *Shoal Harbor and Compton Creek, New Jersey.*—Shoal Harbor is an indentation of the shore on the south side of Sandy Hook Bay, 5 miles west of the entrance to Shrewsbury River. It is bare at low water, and the water deepens so gradually outwards that the 5-foot curve, mean low water, is only reached at a distance of 3,000 feet from the high-water line. Compton Creek, which flows northerly from the west side of the Navesink Highlands and empties into Shoal Harbor, is 5 to 6 miles long, with 3 to 5 feet of water in the lower reach. At one-quarter of a mile from its mouth it is crossed by a fixed bridge, beyond which no boats ever go. Between this bridge and the harbor there is a harbor of refuge of limited capacity, having a depth of 9 feet of water in places, to which fishing vessels resort when the tides allow them to cross the shoals at the entrance. The range of tides is 4.5 feet.

The plan of improvement adopted in 1884 had in view the connection of the 5-foot mean low-water curve of the creek on the inside with the 5-foot curve of the bay, by means of a dredged channel 150 feet wide, and the protection of this channel against shoaling by means of a timber dike placed on the west side of the harbor, at a total estimated cost of $64,130.

An appropriation of $5,000 was made in the act of September 19, 1890, and a project for its expenditure in dredging the channel to a depth of 4 feet mean low water was approved October 9, 1890. The work was advertised February 3, 1891. Bids were opened March 10, and a contract entered into March 20, 1891, with Elijah Brainard for the removal of 16,000 cubic yards, more or less, of material. Work was begun under the contract April 25, and was still in progress at the close of the fiscal year, at which date 10,808 cubic yards of material were removed, giving a channel 980 feet long, 70 feet wide, and 4 feet deep, mean low water.

The amount expended to the close of the fiscal year ending June 30, 1891, is $1,649.80.

The commerce of this stream was reported in 1884 at 25,000 tons annually, against 35,500 tons reported for the calendar year 1890.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	1,649.80
July 1, 1891, balance unexpended	3,350.20
July 1, 1891, amount covered by uncompleted contracts	2,758.93
July 1, 1891, balance available	591.27

Amount (estimated) required for completion of existing project	$59,130.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 13.)

14. *Shrewsbury River, New Jersey.*—When the present project for this improvement was adopted, in 1879, the river was obstructed by a number of shifting sand-bars, which had caused the complete suspension of navigation in the South Branch and only permitted the passage of vessels engaged in commerce up the North Branch at or near high water. A considerable trade was carried on, however, even under these difficult conditions.

The originally adopted project for the improvement was to dredge a channel 6 feet deep at mean low water, and from 300 to 150 feet in width, across the shoals from the mouth to Red Bank, on the North Branch, 8 miles, and Branchport, on the South Branch, 9 miles, maintaining these channels by longitudinal dikes. This project has not been modified as to the end sought, but estimates of the diking, dredging, and cost have been increased from time to time.

The amount expended on this project to the end of the fiscal year ending June 30, 1890, was $214,292.88.

With this amount numerous dikes have been built and channels dredged at various places 6 feet deep and from 25 to 100 feet wide. These improvements have resulted in a marked increase in the commerce.

The work done during the fiscal year consisted in the construction of 372½ linear feet of sheet-pile dike in the North Branch and the removal by dredging of 11,045 cubic yards of material, in redredging the channel of the South Branch to a depth of 6 feet at mean low water.

The amount expended during the fiscal year is $4,205.22.

The commerce of the river was reported for the calendar year 1889 to be 526,000 tons; this has increased to 556,500 tons for the calendar year 1890.

July 1, 1890, balance unexpended		$207.12
Amount appropriated by act approved September 19, 1890		10,000.00
		10,207.12
June 30, 1891, amount expended during fiscal year		4,205.22
July 1, 1891, balance unexpended		6,001.90
July 1, 1891, outstanding liabilities	$800.00	
July 1, 1891, amount covered by uncompleted contracts	3,986.50	
		4,786.50
July 1, 1891, balance available		1,215.40

Amount (estimated) required for completion of existing project	30,062.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	23,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix F 14.)

15. *Manasquan (Squan) River, New Jersey.*—In its original condition this stream had a depth of from 4 to 6 feet at mean low water for several miles above its mouth; but was obstructed at its outlet into the ocean by a sand spit, which had deflected the stream into a channel parallel with the beach communicating with the ocean across shifting sand-bars, on which the best depth did not exceed 1½ feet at mean low water; mean range of tide 2.4 feet. In severe storms this channel was sometimes entirely closed by the sand, remaining so until the fresh

water in the river had accumulated sufficiently to force a new outlet. Under these conditions the river could not be used by commerce.

The project for its improvement was adopted in 1879, and contemplated dredging the lower river, and obtaining by means of jetties a permanent outlet nearly at right angles to the beach, with a depth of 6 feet at mean low water, at an estimated cost of $52,120. This was increased to $72,000, in 1882, the increase being due to advanced prices and to a proposed increase in the length of the jetties.

The amount expended under this project to June 30, 1890, was $39,000.

With this amount two jetties had been constructed, but neither to its full length, appropriations having ceased in 1882. No permanent improvement had been effected.

An appropriation of $2,000 was made in the act of September 19, 1890, to be expended in the removal of obstructions placed by the Government at the mouth of the river, if, in the discretion of the Secretary of War the same should be done. There were no expenditures on account of this work during the fiscal year ending June 30, 1891, as the removal of the obstructions alluded to in the act of September 19, 1890, was, in the opinion of the engineer in charge, deemed unnecessary, and so reported under date of December 19, 1890, and was approved by the Secretary of War December 30, 1890.

Amount appropriated by act approved September 19, 1890	$2,000.00
July 1, 1891, balance unexpended	2,000.00
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	31,000.00

(See Appendix F 15.)

16. *Removing sunken vessels or craft obstructing or endangering navigation.*—The barge *Nellie*, in discharging cargo at Elizabethport, N. J., broke apart in the middle and sank. She was raised by the owners and the cargo removed, and subsequently abandoned, and reported by Mr. D. C. Chase, superintendent of the Pennsylvania Railroad Towing Line, on July 23, 1890, as an obstruction to navigation.

Authority for the removal of this wreck was obtained August 2, 1890, and after due advertisement by circular letter it was removed on September 19, in a very thorough manner, by the Baxter Wrecking Company, at a cost of $200.

(See Appendix F 16.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Princess Bay, Staten Island, New York, for breakwater*, was made by the local engineer in charge, Captain Casey, and report thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Captain Casey, and of the Division Engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 109, Fifty-first Congress, second session. (See also Appendix F 17.)

The required preliminary examination of *Hackensack River, New*

Jersey, from below the Newark and New York Railroad Bridge, on Newark Bay, to the town of Hackensack, was made by the local engineer in charge, Captain Casey, and report thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Captain Casey, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Captain Casey was charged with and has completed its survey, and submitted report thereon. The proposed improvement below the Newark and New York Railroad Bridge contemplates the dredging of a cross-over channel to a width of 200 feet and depth of 10 feet at mean low water from the east (ebb) channel, which passes through the draw span of the bridge to the west (flood) channel; the cost of excavating this cross channel is estimated at $2,500.

The improvement of the upper river, proposed in report of June 30, 1889 (printed in Annual Report, Chief of Engineers, 1889, page 842), on survey of Hackensack River from the lower bridge at the town of Hackensack to the Erie Railway Bridge, contemplates dredging a channel 10 feet deep at mean low water and 200 feet wide from Little Ferry to Gasworks Creek, and 150 feet wide from that point to the lower bridge at Hackensack; the cost of this work was estimated at $60,000.

Captain Casey, in his report of September 5, 1891, on the survey, states:

> In comparison with the upper reaches of the river, as described in my previous report, the lower river is, however, not in need of improvement at present, and it is recommended that any money which may be appropriated be expended on that portion of the river between the lower bridge in the town of Hackensack and the Erie Railway Bridge.

(See Appendix F 18.)

IMPROVEMENT OF DELAWARE RIVER, PENNSYLVANIA AND NEW JERSEY, SCHUYLKILL RIVER, PENNSYLVANIA, AND RIVERS IN SOUTHERN NEW JERSEY; HARBOR IMPROVEMENTS IN DELAWARE RIVER AND BAY; CONSTRUCTION OF PIER AT LEWES, DELAWARE; DELAWARE BREAKWATER, DELAWARE.

Officer in charge, Maj. C. W. Raymond, Corps of Engineers; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Delaware River, Pennsylvania and New Jersey*—Trenton, the head of natural navigation on the Delaware River, is about 30 miles above the upper part of the port of Philadelphia. In its original condition this part of the river was obstructed by shoals at the following localities: Between Bordentown and Trenton, a distance of about 5 miles, a narrow and circuitous channel existed which carried from 3 to 6 feet at mean low water; at Kinkora Bar, about 9 miles below Trenton, a shoal carrying from 7 to 8 feet, and at Five Mile Bar, at the upper part of Philadelphia, a shoal across the Pennsylvania channel carrying only 3 or 4 feet at mean low water, there being, however, 13 feet of water past Five Mile Bar in the New Jersey channel, passing south of Petty Island.

Below Philadelphia the river, in its original condition, presented obstructions at Mifflin Bar, which reduced the depth at mean low water to 17 feet, at Schooner Ledge and Cherry Island Flats to 18 feet, at Bulkhead Shoals and Dan Baker Shoal to about 20 feet.

In that part of the Delaware River between Trenton, N. J., and Bridesburg, Pa., efforts in the past have been directed toward relieving com-

merce from the obstructions which exist in the upper 9 miles of the river, or that part between Kinkora Bar and Trenton. A detailed survey of the river between Bridesburg and Trenton has been made for the purpose of obtaining the necessary data for determining upon a plan for the improvement of the river between Trenton and the upper part of Philadelphia to meet the requirements of commerce.

Previous to 1885 the efforts to improve the river between Philadelphia and the bay have been confined to dredging, except at Schooner Ledge, where solid rock has been removed, under appropriations for special localities, and also under general appropriations for the Delaware River below Bridesburg.

A Board of Engineers, convened by direction of the Secretary of War for the purpose of considering the subject of the permanent improvement of Delaware River and Bay, recommended, under date of January 23, 1885, the formation of a ship channel from a point opposite Philadelphia and about midway between the American Shipbuilding Company's yard and the Gas Trust Wharf to deep water in Delaware Bay, having a least width of 600 feet and a depth of 26 feet at mean low water. The formation of such a channel is to be obtained, except at Schooner Ledge, where rock would require to be removed, by regulating the tidal flow by means of dikes, with recourse to dredging where necessary as an aid to such contracting and regulating works. The estimated cost of obtaining a channel of the above dimensions is about $2,425,000, which covers the estimated cost of the permanent improvement of the Delaware River between the upper part of Philadelphia and deep water in the bay. This estimate of cost does not include the improvement of Philadelphia Harbor, which is a separate project. With the present requirements of commerce above Philadelphia it is not considered that the part of the river lying between Trenton and Bridesburg demands any improvement beyond the formation of a 12-foot navigable channel across Kinkora Bar.

The entire amount expended on the improvement of the Delaware River from 1836 to June 30, 1890, under appropriations both for special localities and the general river, was $1,942,941.78, of which $104,132.84 was expended on that part of the river between Trenton and the upper part of Philadelphia. As a result of this expenditure there had been formed at the latter date a channel of navigable width and 7½ feet deep at mean low water through the bars between Bridesburg and Bordentown; a channel across Five Mile Bar 11½ feet deep, and past the bar, between its south side and Petty Island a channel 9 feet deep; a channel from 200 to 400 feet wide and from 24 to 26 feet deep through the shoal areas at Port Richmond; a channel across Mifflin Bar from 150 to 250 feet wide and from 24 to 26 feet deep; a channel through Schooner Ledge 330 feet wide and 24 feet deep, except over a small area discovered in 1889 where the depth is reduced to 23 feet at mean low water; a channel through Cherry Island Flats from 200 to 450 feet wide and from 24 to 26 feet deep, and a channel across Bulkhead Shoal 600 feet wide and from 20 to 21 feet deep.

The channel between Philadelphia and Camden, across Smith Island Bar, had been improved by the formation of a dredged cut protected by revetment, so as to give a channel 100 feet wide with a minimum depth of 6 feet at mean low water.

During the fiscal year ending June 30, 1891, the sum of $37,417.77, which includes the liabilities outstanding June 30, 1890, was expended in surveys, examinations, and in dike construction and dredging at Kinkora and Bulkhead Bars; making a total expenditure since 1836

of $1,980,359.55, of which $628,359.55 has been expended on present project.

The changes which have resulted during the past fiscal year are summarized as follows: At Kinkora Bar, 600 linear feet of pile and stone and 200 linear feet of stone and mud dike were built, partly closing the slough south of Newbold Island, and a channel about 175 feet wide and 12 feet deep at mean low water was dredged across the bar; this channel for a width of 150 feet now carries a depth of 9½ feet at mean low water. At Five Mile Bar a channel about 150 feet wide and 13 feet deep at mean low water exists, which is the result of the action of the dike between Fisher Point and Petty Island, as completed during the fiscal year ending June 30, 1890. At Mifflin Bar the channel carries a depth of from 24 to 26 feet at mean low water in a channel from 175 to 275 feet wide; the dike at Mifflin Bar was completed to the plane of mean low water in 1888, except for a gap of 400 feet, which serves as an entrance to the dumping basin, and its action upon the channel dredged through the bar in the fall of 1888 shows that the effect of the dike, though manifest upon the bar, will probably have to be increased by raising the dike in the future to a greater height above the plane of mean low water. At Bulkhead Bar the east dike, which has been in progress of construction during the past fiscal year, has reached a length of 2,600 feet; its extension has not yet been sufficient to affect the channel over the bar, and as a temporary relief to commerce a channel about 200 feet wide and 24 feet deep at mean low water is now being dredged.

The channels at Schooner Ledge and Cherry Island Flats have remained unchanged from their condition as reported for the previous fiscal year. No extension has been made during the year to the dike at Reedy Island, which is intended for the improvement of Dan Baker Shoal.

July 1, 1890, balance unexpended		$69,058.22
Amount appropriated by act approved September 19, 1890		240,000.00
		309,058.22
June 30, 1891, amount expended during fiscal year		37,417.77
July 1, 1891, balance unexpended		271,640.45
July 1, 1891, outstanding liabilities	$12,803.51	
July 1, 1891, amount covered by uncompleted contracts	72,563.82	
		85,367.33
July 1, 1891, balance available		186,273.12
Amount (estimated) required for completion of existing project		1,725,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00
Submitted incompliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix G 1.)

2. *Harbor between Philadelphia, Pennsylvania, and Camden, New Jersey.*—The islands in the Delaware River between Philadelphia and Camden compel the flood and ebb currents to pursue different paths, narrow the existing channels, and prevent the extension of wharves necessary for the purposes of commerce. The plan of improvement adopted by Congress provides for the removal of Smith and Windmill islands and a part of Petty Island, and the formation of a channel of ample depth and about 2,000 feet in width from Kaighn Point to to Fisher Point. The project contemplates the advance of wharves and bulkheads on both the Philadelphia and Camden shores during the

progress of the work. The excavation is to be done by the General Government. The advance of wharves and bulkheads is under the control of the local authorities and private owners, a portion of the material to be removed by the Government being considered available for the necessary filling. The estimated cost of the work to be done by the United States, exclusive of the cost of the islands, is $3,500,000.

The river and harbor act of August 11, 1888, appropriated $500,000 for the work, of which not to exceed $300,000 was to be applied to the purchase of the islands.

During the fiscal year ending June 30, 1890, the legal proceedings for the condemnation of the islands were completed. The commissions appointed by the courts awarded the owners of Smith and Windmill Islands the sum of $484,000, and of Petty Island $202,288.50; the legal costs of the condemnation proceedings were $22,364 36; making the aggregate cost of the islands $708,652.86.

In payment of this award the State of Pennsylvania appropriated $200,000, the city of Philadelphia $208,652.86, and the balance, $300,000, was provided from the appropriation of Congress in the river and harbor act of August 11, 1888. The payment of these amounts by the State, city, and General Government was made, and the property taken deeded to the United States.

During the fiscal year ending June 30, 1890, $300.177.91 was expended in the purchase of the islands and in the preparation of a project for the application of the funds available for the commencement of the work.

During the fiscal year ending June 30, 1891, $9,848.17 was expended in making necessary surveys for establishing harbor lines and determining the details of the work and for office expenses.

Proposals for the commencement of the improvement were opened on September 16, 1890, but in view of new legislation during their consideration all the bids were rejected.

The river and harbor act of September 19, 1890, contained an appropriation of $200,000 for continuing the improvement, and provided that the Secretary of War might enter into contracts for the work required, to be paid for as appropriations may from time to time be made by law; the work to be done according to the plan of the Board of Engineers of 1888, or such modifications thereof as may be determined upon by the Secretary of War without increasing the cost of the improvement.

Proposals for the entire work were opened on February 12, 1891, but pending their consideration new legislation materially changed the conditions under which the improvement is to be executed, and all the bids were accordingly rejected.

The sundry civil act of March 3, 1891, appropriated $300,000 for continuing the improvement, and provided that the line limiting the excavation on Petty Island might be changed to such position as the Secretary of War might consider desirable, title to the necessary additional lands to be vested in the United States without charge to the latter. It further required that all material removed under this and previous appropriations should be deposited and spread on League Island, the cost to be paid from said appropriations. Since the use of a portion of this material for filling is necessary for the advance of shore lines provided for in the project adopted by Congress in the act of September 19, 1890, this legislation is a modification of the adopted project so far as it relates to the expenditure of funds now available.

Under date of April 23, 1891, a contract was entered into with James

A. Mundy & Co., of Philadelphia, Pa., for all the work required for the improvement.

July 1, 1890, balance unexpended	$199,822.09
Amount appropriated by act approved September 19, 1890	200,000.00
Amount appropriated by sundry civil act approved March 3, 1891	300,000.00
	699,822.09
June 30, 1891, amount expended during fiscal year	9,848.17
July 1, 1891, balance unexpended	689,973.92
July 1, 1891, amount covered by uncompleted contracts	689,973.92

Amount (estimated) required for completion of existing project	2,800,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix G 2.)

3. *Schuylkill River, Pennsylvania.*—When the work of improvement was commenced in 1870, there was a channel of entrance into the mouth of the river carrying a depth of only 10 feet at mean low water.

The original project under which work was commenced in 1870 proposed the formation of a channel 100 feet wide, with a depth of 20 feet from the mouth of the river to Gibson Point, about 4 miles, and a depth of 18 feet from thence to Chestnut Street Bridge in Philadelphia, about 3 miles.

In 1875 and 1883 this project was amended so as to increase the low-water channel between the mouth and Girard Point, a distance of about 1 mile, to 400 feet wide and 24 feet deep, and from Girard Point to Gibson Point, about 3 miles, to 250 feet wide and 20 feet deep.

The amount expended upon these projects to June 30, 1890, was $393,527.65 and had resulted in the formation of a channel as follows: Between the mouth and Girard Point Piers the minimum channel was 150 feet wide and from 18 to 19 feet deep at mean low water; from Girard Point to Point Breeze the channel was 250 feet wide and 20 feet deep, except for about three-fifths of a mile directly above Penrose Ferry Bridge, where the 20-foot channel was only 100 feet wide; from Gibson Point to Chestnut Street Bridge the channel was of navigable width and 18 feet deep at mean low water. This latter reach of river has required no other improvement than the removal of about 1,000 cubic yards of rock near Locust and South streets.

During the fiscal year ending June 30, 1891, $20,205.06 was expended in widening to 250 feet the 20 foot low-water channel directly above Penrose Ferry Bridge, and to 300 feet the channel at Yankee Point.

In its present condition a channel 100 feet wide and from 18 to 20 feet deep at mean low water exists over the bar at the mouth; from thence to Point Breeze a channel from 200 to 250 feet wide and 20 feet deep; from thence to Chestnut Street Bridge a channel of navigable width and from 17 to 20 feet deep at mean low water.

July 1, 1890, balance unexpended	$222.35
Amount appropriated by act approved September 19, 1890	45,000.00
	45,222.35
June 30, 1891, amount expended during fiscal year	20,205.06
July 1, 1891, balance unexpended	25,017.29

Amount (estimated) required for completion of existing project	$46,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	46,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 3.)

4. *Ice-harbor at Marcus Hook, Pennsylvania.*—This work in its present plan was commenced in 1866, the object being to provide a harbor in the Delaware River to protect vessels against moving ice.

In 1785 the Commonwealth of Pennsylvania built, for the convenience of commerce, piers at Marcus Hook extending from the shore line into the river. It is assumed that at some subsequent time these shore piers were turned over to the United States, since in 1829 an appropriation was made of $5,000 for repairing these piers, improving the harbor, and removing obstructions. No further appropriation was made until 1866.

At this latter date the project was adopted for the construction of detached piers in the harbor, consisting of stone superstructures upon crib foundations filled with stone, together with the deepening of the harbor by dredging.

In 1881 it was proposed to increase the area of the harbor by the construction of a bulkhead about 1,800 feet in length parallel to the shore line, and about 150 feet outside of high-water line, and the deepening of this added area by dredging. Nothing was done towards the carrying into effect of the modification of 1881, on account of the objections of some of the abutting property owners, and in 1888 this hitherto proposed modification was abandoned and an increased depth proposed for the areas protected by the detached piers outside of the natural shore line of the river.

The amount expended from 1866 to June 30, 1890, was $208,497.89, and resulted in the construction of two shore or landing piers, and seven detached ice piers, the deepening by dredging of the area protected by the piers, and the placing of mooring piles within the harbor. By this expenditure a harbor was formed with an area of about 10 acres, carrying a depth of from 12 to 25 feet at mean low water.

During the fiscal year ending June 30, 1891, $465.75 was expended upon office expenses.

It is proposed to hold available funds for such incidental repairs as may be required from time to time.

July 1, 1890, balance unexpended		$502.11
Amount appropriated by act approved September 19, 1890		5,000.00
		5,502.11
June 30, 1891, amount expended during fiscal year		465.75
July 1, 1891, balance unexpended		5,036.36

(See Appendix G 4.)

5. *Ice-harbor at head of Delaware Bay, Delaware.*—The act of August 2, 1882, appropriated $25,000 for the commencement of work on the ice-harbor at the head of Delaware Bay, to include the removal of some sunken piers, the remains of an old ice-harbor, in the channel east of Reedy Island, Delaware.

The desirability of an ice-harbor at the head of Delaware Bay has been long recognized, but until the improvement of the main ship channel shall have been materially advanced it is believed that appropriations can be applied, with better results to commerce, to the improvement of the channel rather than to the formation of an ice-harbor suited

to the requirements of the case. As to location, the prevailing judgment would place the ice-harbor at or very near Liston Point, but since the works already planned for the improvement of the channel in this part of the river involve the construction of about 11 miles of dikes, the changes which may result from such extensive constructions render the prior location of an ice-harbor hazardous.

The amount expended to June 30, 1890, was $8,723.07, of which $3,700 was applied to the removal of the sunken piers back of Reedy Island, as provided in the act of August 2, 1882, making the appropriation of $25,000. The balance was expended in surveys, examinations, and preliminary studies.

During the fiscal year ending June 30, 1891, $40 was expended upon office expenses.

July 1, 1890, balance unexpended	$16,276.93
June 30, 1891, amount expended during fiscal year	40.00
July 1, 1891, balance unexpended	16,236.93

(See Appendix G 5.)

6. *Construction of iron pier in Delaware Bay near Lewes, Delaware.*—The original project for this work proposed the construction of a landing pier about 1,700 feet in length, extending from the shore south of the breakwater into Delaware Bay to a depth of 22 feet at mean low water, the pier to consist of a substructure of wrought iron screw piles surmounted with a timber superstructure. The work was commenced in 1871, and completed, except as to superstructure, in 1880.

The amount expended to June 30, 1890, was $368,453.66, and resulted in the construction of 1,155 linear feet of pier 21 feet in width, and 546 linear feet 42 feet in width, or a total length of 1,701 feet. The depth of water at the outer end of the pier head was about 21 feet at mean low water.

During the fiscal year ending June 30, 1891, $9,623.89 was expended in replacing about 200 linear feet of the pier destroyed by the collisions of wrecked vessels in 1889, and in placing fender piles along 1,200 linear feet of the shore arm of the pier.

From the decayed condition of the timber superstructure of a large part of the pier it is not available for use by the railroad to which the right was given to use the pier under the provisions of the act of July 15, 1870.

If the pier is to be rendered available for the general purposes of railroad traffic, as contemplated in the act above referred to, it will be necessary to replace the present decayed wooden superstructure by an iron construction, which has been estimated at $93,000.

The sundry civil act of March 3, 1891, contained the following provision:

> And the Secretary of War is hereby directed to assign to the Secretary of the Treasury so much space on the Lewes iron pier as may be necessary to enable the Marine Hospital Service to establish and conduct thereon such disinfection machinery as may be required for the proper disinfection of the cargoes of vessels detained at the quarantine, and when the breakwater shall have been completed then the said pier shall be permanently assigned to the Treasury Department: *Provided*, That such occupation and use of the pier by the Marine Hospital Service does not interfere with the engineering operations of the War Department in the completion of the breakwater improvement.

It is understood that the use of the pier as above provided will at times prohibit its use for any other purpose. The pier is of considerable value to vessels frequenting the breakwater harbor, being the

only communication with the shore; it is necessary for the purposes of the light-house service, and its free use at all times will probably be indispensable for many years for the engineering operations of the War Department. It is therefore suggested that other arrangements be made for the requirements of the quarantine service.

July 1, 1890, balance unexpended	$10,046.34
June 30, 1891, amount expended during fiscal year	9,623.89
July 1, 1891, balance unexpended	422.45

(See Appendix G 6.)

7. *Harbor at Delaware Breakwater, Delaware.*—Under act of Congress, May 7, 1822, $22,700 was appropriated for a survey of Delaware Bay, near Cape Henlopen, for the purpose of determining upon the site for a harbor of shelter. In 1828 an appropriation of $250,000 was made for commencing the work under a plan submitted by a board of commissioners appointed by Congress.

The project of the board contemplated the construction in the concavity of the bay, just inside Cape Henlopen, of two massive works on the pierres perdues or riprap system, separated by an interval or gap of 1,350 feet, the greater, called the breakwater, to afford safe anchorage during gales from the north and east; the other, called the ice-breaker, to protect shipping against northwesterly gales and the heavy drifting ice of the bay.

This project was completed in 1869, under aggregate appropriations, including the first for survey, of $2,192,103.70. The stone used in the work amounted to 892,528 gross tons, and varied from one-quarter of a ton to 7 tons in weight, the smaller constituting the bulk of the mass, the larger used to cover the exterior slopes.

As completed in 1869 the breakwater is 2,558 feet long, and the ice-breaker 1,359 feet long on top. The average width on top is 22 feet and at base 160 feet. The top is from 12 to 14 feet above mean low water.

In 1882 a project was adopted for closing the gap between the breakwater and the ice-breaker by means of a random stone foundation with a concrete superstructure. The random stone foundation was to be brought to a height of 12 feet below low water, with a width on top of 48 feet. The concrete superstructure to have a width on bottom of 24 feet rising to a height of 12 feet above mean low water, with a width on top of 12 feet. The estimated cost of this project was $675,000.

In 1883 and 1884 the project was modified by providing a foundation of brush mattresses for the random-stone superstructure and omitting the construction of a pile bridge across the gap, which formed part of the project of 1882 for closing the gap.

In 1890 the concrete superstructure was further modified by establishing its base at 15 feet below mean low water, by making it rectangular in section, with a width of 27 feet and height of 27 feet, and by constructing the work to above the plane of high water of large concrete blocks, above which concrete in mass is to be used. The estimated cost of the modified project, including the $356,250 appropriated from 1882 to 1888, was $856,250.

In 1891, the random stone substructure having been practically completed, the project for the hitherto proposed concrete superstructure was modified by substitution of random stone for the remaining part of the work, so as to raise the structure to a height of 14 feet above mean low water with a width on top of 20 feet; the width at low water to be

40 feet and the slopes below this plane to be such as may be formed by the action of the sea; between low water and the top the slopes to be about 1 on 0.7 formed by heavy stones laid in position. The estimated cost of completing this part of the work is $400,000, or, including the $356,250 appropriated from 1882 to 1888, the cost of closing the gap is $756,250.

From the beginning of the work in 1822 to June 30, 1890, the total amount expended was $2,547,125.92, of which $355,022.22 was expended on the project of 1882 for closing the gap.

During the fiscal year ending June 30, 1891, $2,029.87 was expended in surveys and office expenses. The total expenditure to June 30, 1891, has been $2,549,155.79, of which $357,052.09 has been under the present project for closing the gap.

The increase in the dimensions and draft of vessels since the present harbor was designed in 1822, together with the shoaling which has ensued behind the breakwater, renders the present harbor under these changed conditions inadequate for the requirements of commerce. Upon the completion of the present project of closing the Gap, additional anchorage area will be added to the harbor and make it of great and continued value to coasting vessels.

July 1, 1890, balance unexpended	$1,227.78
Amount appropriated by act approved September 19, 1890	80,000.00
	81,227.78
June 30, 1891, amount expended during fiscal year	2,029.87
July 1, 1891, balance unexpended	79,197.91
July 1, 1891, amount covered by uncompleted contracts	75,082.00
July 1, 1891, balance available	4,115.91
Amount (estimated) required for completion of existing project	320,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	320,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 7.)

8. *Rancocas River, New Jersey.*—In its natural condition Rancocas River carried a minimum low-water depth of about 4½ feet between the mouth and Centerton, a distance of about 7½ miles, and from Centerton to Mount Holly, a distance of about 5½ miles, a ruling depth of about 2½ feet.

The original project of 1881 proposed the formation, by a dike at Coats Bar and dredging elsewhere, of a channel from 150 to 200 feet wide and 6 feet deep at mean low water from the mouth to Centerton, and from thence to Mount Holly a channel 5 feet deep.

Operations were carried on under this project from 1881 to 1884, under appropriations aggregating $20,000 made in 1881 and 1882. To the close of the fiscal year ending June 30, 1890, $19,899.91 had been expended in the formation of a 6-foot channel over Coats Bar and its vicinity by dike construction and dredging.

During the fiscal year ending June 30, 1891, $8,802.73 was expended in the removal of three wrecks, and in deepening to 6 feet at mean low water for a channel 100 feet wide the shoal areas between the mouth and Centerton.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	8,802.73
July 1, 1891, balance unexpended	1,197.27

Amount (estimated) required for completion of existing project.....	$51,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 8.)

9. *Alloway Creek, New Jersey.*—In its original condition Alloway Creek was obstructed between its mouth and Quinton, a distance of about 10½ miles by shoal areas in the upper half of the stream, which reduced the low-water depths to about 4 feet.

The original project of 1889 proposed the formation by dredging of a channel 6 feet deep at mean low water, and 60 feet wide from Quinton to a point about 1,000 feet above the upper Hancock Bridge; from thence a channel of the same depth and 75 feet wide. At a locality known as the Canal, in addition to a channel of the last named dimensions, the width of the stream was to be increased to about 150 feet between its low-water lines.

The appropriation of $6,000 by the act of September 19, 1890, was the first made for this work.

During the fiscal year ending June 30, 1891, $3,467.88 was expended in deepening to 6 feet at mean low water the channel at the Canal, Square, and upper Hancock Bridge.

Amount appropriated by act approved September 19, 1890		$6,000.00
June 30, 1891, amount expended during fiscal year		3,467.88
July 1, 1891, balance unexpended		2,532.12
July 1, 1891, outstanding liabilities	$330.14	
July 1, 1891, amount covered by uncompleted contracts	1,198.62	
		1,528.76
July 1, 1891, balance available		1,003.36

Amount (estimated) required for completion of existing project.....	19,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	19,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix G 9.)

10. *Maurice River, New Jersey.*—In charge of W. F. Smith, United States Agent, Major of Engineers, U. S. Army, Retired, to October 2, 1890. In its original condition Maurice River had a depth of 5 feet at mean low water over the bar at its mouth, and a channel of over 10 feet deep extending from its mouth for a distance of about 20 miles, or to within 4 miles of Millville. For the remaining distance of about 5 miles, to the head of navigation at Millville, there were shoal areas which reduced the low-water depth to about 2 feet.

The original project of 1881 proposed the formation by dredging of a channel 100 feet wide and 6 feet deep at mean low water through the 4 miles of river below Millville Bridge, and from thence to the head of navigation a channel of the same width and 4 feet deep. In 1891 the project was modified by extending the 6-foot channel to the head of navigation.

At the close of the fiscal year ending June 30, 1890, $28,816.83 had been expended in carrying the 6 foot channel from a point 4 miles below to about 1,000 feet above Millville Bridge.

During the fiscal year ending June 30, 1891, $6,099.40 was expended in extending the previously dredged channel for a further distance of about 400 feet above the point reached at the close of the previous fiscal year.

July 1, 1890, balance unexpended	$6,183.17
Amount appropriated by act approved September 19, 1890	8,000.00
	14,183.17
June 30, 1891, amount expended during fiscal year	6,099.40
July 1, 1891, balance unexpended	8,083.77
July 1, 1891, amount covered by uncompleted contracts	4,750.00
July 1, 1891, balance available	3,333.77

(See Appendix G 10.)

11. *Removal of wrecks from Delaware Bay and River.*—During the past fiscal year no wrecks have been removed under this appropriation.

July 1, 1890, balance unexpended	$734.08
July 1, 1891, balance unexpended	734.08

(See Appendix G 11.)

12. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the past fiscal year the following wrecks were removed under the provisions of the act of June 14, 1880: The schooner *Gen. W. T. Sherman*, from Delaware Bay; the steamer *Mediator*, from Barnegat Inlet, New Jersey.

(See Appendix G 12.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Raymond, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Major Raymond, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys of these localities were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Shark River, New Jersey.*—Printed as House Ex. Doc. No. 25. (See also Appendix G 13.)

2. *Sound between Barnegat Bay and Great Egg Harbor Bay, New Jersey.*—Printed as House Ex. Doc. No. 42. (See also Appendix G 14.)

3. *Little Egg Harbor Bay and Inlet, including Great Bay, New Jersey, with reference to establishing a harbor of refuge.*—Printed as House Ex. Doc. No. 23. (See also Appendix G 15.)

4. *Thoroughfare from Cape May to the Great Bay north of Atlantic City, New Jersey.*—Printed as House Ex. Doc. No. 50. (See also Appendix G 16.)

5. *Cape May City, New Jersey, for breakwater.*—Printed as House Ex. Doc. No. 39. (See also Appendix G 17.)

6. *Pensauken Creek, New Jersey.*—Printed as House Ex. Doc. No. 31. (See also Appendix G 18.)

7. *The West Branch of the Susquehanna River in the State of Pennsylvania, in order to ascertain if the navigation of said river can be materially and permanently improved by the construction of embankments or otherwise; such survey also to be made with a view of ascertaining the best*

practicable method of confining the waters of said river in times of great flood, to the general course of its channel.—Printed as House Ex. Doc. No. 136. (See also Appendix G 19.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Raymond, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Major Raymond, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. This opinion being concurred in by me, Major Raymond was charged with and has completed their survey and submitted reports thereon.

1. *Toms River, New Jersey.*—The improvement proposed contemplates dredging a channel 75 feet wide and 6 feet deep at mean low water from the bridge at the village of Toms River to the 6-foot curve below, a distance of about 3,500 feet. The cost of the work is estimated at $10,000. (See Appendix G 20.)

2. *Goshen Creek, New Jersey.*—The improvement proposed contemplates dredging a channel below Goshen Landing to a low-water depth of 3 feet and width of 30 feet, dredging a channel 3 feet deep and about 50 feet wide through the bar at the mouth of the creek and out to the limit of the sand formation beyond the low-water shore line, and the protection of the dredged channel by a sheet-pile jetty on the south side of the channel extending about 600 feet outside of the low-water line of the bay. The cost of the work is estimated at $12,000. (See Appendix G 21.)

EXAMINATION FOR SITE FOR HARBOR OF REFUGE FOR DEEP-DRAFT VESSELS NEAR MOUTH OF DELAWARE BAY, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

In compliance with the provisions of the act a Board of Engineers, consisting of Col. Wm. P. Craighill, Major C. W. Raymond, and Capt. W. H. Bixby, Corps of Engineers, was constituted by the Secretary of War to examine "Delaware Bay, with a view of determining the best site near the mouth of the same for a national harbor of refuge suitable for deep-draft vessels" and submit "report thereon, with a project and estimate of cost of construction of such a harbor of refuge." The report of the Board will be submitted when received. A preliminary report, dated December 11, 1890, is submitted as Appendix G 22.

IMPROVEMENT OF RIVERS AND HARBORS IN DELAWARE AND ON EASTERN SHORE OF CHESAPEAKE BAY, MARYLAND AND VIRGINIA, AND OF INLAND WATER-WAY FROM CHINCOTEAGUE BAY, VIRGINIA, TO DELAWARE BAY, DELAWARE.

Engineer in charge, William F. Smith, United States Agent, Major of Engineers, U. S. Army, Retired; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Wilmington Harbor, Delaware.*—Before 1836, when the first appropriation for the improvement of Christiana River was made, the depth of water at the entrance into the Delaware River was about 8½ feet. The shoalest place inside the river below the Third Street Bridge was 8 feet. The depth in the channel was increased that year by dredging to 10 feet. Under a project commenced in 1871 and completed in 1881, a 12-

foot channel was made from the mouth to above the city of Wilmington. The project now in force was made in 1881, and is for a 15 foot low-water channel from the mouth to the Pulp Works, 150 feet wide from the mouth to the Rolling Mill Wharf, 100 feet wide to the Delaware and Western Railroad Bridge, and 75 feet in width to the Pulp Works; also for a channel 50 feet wide and 12 feet deep above these works, as far as the Delaware Railroad Bridge, and for a jetty at the mouth of the river. The estimate, which was $175,551, was increased in 1883 to $191,384 by changing the width of the proposed channel to 150 feet as far as the Pulp Works. A further amendment of the project was made in 1884, when 4 feet was added to the height of the jetty and its length increased 322 feet. Up to the close of the fiscal year ending June 30, 1890, $170,914.44 had been expended under this project. There was then a channel 15 feet deep and 150 feet wide extending from the mouth to near the outlet of Brandywine Creek. The channel above this point, which had previously been dredged to Third Street Bridge, had partly filled up again.

During the fiscal year ending June 30, 1891, the proposed channel was extended from the mouth of the Brandywine Creek to a point 600 feet above the Third Street Bridge, a distance of 5,200 feet, and $17,143.39 was expended. The work was still in progress at the close of the fiscal year, but will be completed in August next.

In compliance with the provisions of the river and harbor act approved September 19, 1890, a Commission, consisting of Col. D. C. Houston and Major C. W. Raymond, Corps of Engineers, and Mr. L. Y. Schermerhorn, civil engineer, was constituted by the Secretary of War to make a survey of Wilmington Harbor and submit report thereon, with project for improvement. The report of the commission was submitted under date of June 18, 1891.

July 1, 1890, balance unexpended		$2,835.56
Amount appropriated by act approved September 19, 1890		30,000.00
		32,835.56
June 30, 1891, amount expended during fiscal year		17,143.39
July 1, 1891, balance unexpended		15,692.17
July 1, 1891, outstanding liabilities	$5,365.27	
July 1, 1891, amount covered by uncompleted contracts	5,172.80	
		10,538.07
July 1, 1891, balance available		5,154.10
Amount (estimated) required for completion of existing project		87,634.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		87,634.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix H 1.)

2. *Ice-harbor at New Castle, Delaware.*—The ice-harbor at New Castle is one of the oldest in the Delaware River, its construction for the protection of shipping against floating ice having been commenced during colonial times. Since the beginning of the present century its improvement has been carried on by the General Government at various intervals, the total amount expended up to the close of the fiscal year ending June 30, 1890, being $223,337.50. The amount expended during the fiscal year ending June 30, 1891, is $255.65.

The present project is to remove one of the piers, which is in a dangerous condition, and to build a new one on the north or up river end of the harbor. Plans for the new pier have been prepared.

July 1, 1890, balance unexpended	$7,346.44
Amount appropriated by act approved September 19, 1890	8,100.00
	15,446.44
June 30, 1891, amount expended during fiscal year	255.65
July 1, 1891, balance unexpended	15,190.79

(See Appendix H 2.)

3. *Appoquinnimink River, Delaware.*—This stream is a tidal tributary of Delaware Bay, flowing mainly through New Castle County, Del. It is navigable for vessels of light draft from the mouth to the town of Odessa, a distance of 9 miles. A bar, having only 1½ feet of water over it at low tide, obstructs the mouth of the river. The average rise and fall of the tide is 6 feet at the bar and 3.2 feet at Odessa.

The project for improvement proposed in a report on a survey made in 1889 and adopted under an appropriation made by the act approved September 19, 1890, provides for dredging a channel 8 feet deep at mean low water, with a width of 100 feet from the mouth to New Bridge, near Townsend's Wharf, and thence 80 feet wide as far as the county bridge at Odessa, the estimated cost of the improvement being $39,963.

During the past fiscal year a channel was dredged near Odessa, 1,975 feet long, 80 feet wide, and 8 feet deep at low water. The amount expended was $4,963.72.

The increased depth and width made the channel at once available for deeper draft vessels and increased the harbor area.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	4,963.72
July 1, 1891, balance unexpended	36.28
Amount (estimated) required for completion of existing project	34,963.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 3.)

4. *Smyrna River, Delaware.*—This river was formerly called Duck Creek, the name having been changed in 1889 by the State legislature.

Before improvements began, in 1879, there was a minimum depth of 2½ feet inside the creek and 4 feet over the bar at the mouth. Navigation was possible only at high tide, and was carried on by one steamer and seven small schooners.

In 1878 a project was made for the improvement of the whole river, which included also a plan for deepening the channel across the bar at the mouth. By special direction of Congress the improvement of the bar was commenced first, and during the following four years three appropriations, aggregating $10,000, were made and expended in dredging a channel across the bar 100 feet wide and 8 feet deep at mean low water. This channel soon filled up again.

A new project was submitted in 1887 for a 7-foot low-water channel 60 feet wide inside the river and 100 feet wide across the bar at the mouth, the latter channel to be protected on each side with stone jetties. The estimated cost of the project was $90,698.40.

At the close of the fiscal year ending June 30, 1890, the sum of $10,000 had been expended on this project. This money was applied by special direction of Congress to dredging inside the river. A channel had been dredged from Smyrna Landing to Brick Store Wharf for a distance of

3 miles, having a width of 40 feet and a depth of 6 feet at mean low water. The immediate result was that vessels of that draft could go 2 miles further up the river and the main shipping point was brought that much nearer the town of Smyrna.

The appropriation of $5,000 made September 19, 1890, is being applied in continuing improvement. The work is now in progress.

During the fiscal year ending June 30, 1891, the sum of $2,536.35, including outstanding liabilities, was expended and the channel between Smyrna Landing and Rothwell Landing had been deepened to 6½ feet. The amount of material removed was 13,139 cubic yards. With increased dimensions in every direction, the channel is becoming more useful and is safer for navigation at low stages of the tide, and an increase in the size and tonnage of vessels is in contemplation.

Amount appropriated by act approved September 19, 1890		$5,000.00
June 30, 1891, amount expended during fiscal year		302.72
July 1, 1891, balance unexpended		4,697.28
July 1, 1891, outstanding liabilities	$2,233.63	
July 1, 1891, amount covered by uncompleted contracts	2,125.00	
		4,358.63
July 1, 1891, balance available		338.65
Amount (estimated) required for completion of existing project		22,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix H 4.)

5. *St. Jones River, Delaware.*—The improvement of this river was reported as completed at the close of the fiscal year ending June 30, 1890, and no further appropriation was recommended.

July 1, 1890, balance unexpended	$490.52
June 30, 1891, amount expended during fiscal year	490.52

(See Appendix H 5.)

6. *Mispillion Creek, Delaware.*—The entrance to this creek has a mean low-water depth of only 1½ feet. Within the stream the original depth was from 4 to 5 feet. The existing project is for a 6-foot low-water channel 40 feet wide from Milford, at the head of navigation, to the mouth. Seventeen thousand dollars has been expended, and with the exception of a shoal very near the mouth the projected channel has been completed. Nothing was done during the past fiscal year for want of funds.

Amount (estimated) required for completion of existing project	$2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 6.)

7. *Broadkiln River, Delaware.*—In its original condition, the depth of water in the river was from 3 to 4 feet at the numerous shoals which impeded navigation. At the entrance the depth was, and still is, from 1½ to 2 feet at mean low tide.

A project for a 6-foot low-water navigation inside the river from the mouth to Milton, Del., and for a new entrance across Lewes Cape was adopted in 1871, and since that year the execution of the portion of the project relating to dredging inside has been in progress and was completed on October 30, 1890.

Up to the close of the fiscal year ending June 30, 1890, the sum of $26,123.19 had been expended. The proposed channel was then com-

pleted from Milton, the head of navigation, to a point 4,690 feet below Green Island or about 1 mile above the mouth of the river. The result was of much benefit to navigation and caused an increase in shipping.

At the beginning of the year ending June 30, 1891, dredging operations under contract with the American Dredging Company were in progress. The contract was completed October 30, 1890, the total amount of material removed under it being 104,284 cubic yards. About one-half of this amount was excavated in making a continuous channel from Green Island to the mouth and the remainder in cutting off sharp turns and in removing a few shoals in the upper portion of the river.

The amount expended during the fiscal year ending June 30, 1891, is $8,876.81. The result is as above, and the channel is now completed from Milton to the mouth of the river in accordance with the project.

July 1, 1890, balance unexpended	$8,876.81
June 30, 1891, amount expended during fiscal year	8,876.81
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	21,500.00

(See Appendix H 7.)

8. *Inland water-way from Chincoteague Bay, Virginia, to Delaware Bay, at or near Lewes, Delaware.*—This improvement is made with the view of forming an inland navigation route, about 75 miles in length, between Chincoteague Bay, Virginia, and Delaware Bay, at or near Lewes, Del.

The project adopted in 1886 contemplates an open channel 70 feet wide at the bottom and 6 feet deep below the mean low-water level established in the Delaware Breakwater Harbor, beginning in Chincoteague Bay and following approximately deep water in Synepuxent, Isle of Wight, and Assawoman Bays; thence across the country for about 4 miles between Little Assawoman Bay and Indian River Bay into and along the latter bay and up Rehoboth Bay; thence from the head of Rehoboth Bay across the intervening high land, for a distance of about 8 miles, to the Delaware Bay. The originally estimated cost of the improvement was $350,000. There are several shoals within the bays named where the depth of water is only 2½ feet. The amount of commerce that will be created by this improvement is estimated at $2,000,000 per annum.

Three appropriations have been made for this work—one of $18,750 and one of $50,000 to be expended between Chincoteague Bay and Indian River Bay, and one of $50,000 to be expended between Chincoteague Bay and Delaware Bay.

Up to June 30, 1890, $23,019.26 had been expended in connecting the waters of Assawoman Bay and Indian River Bay by a cut about 4 miles long across the intervening high land. About 1 mile of the cut was finished to the required depth and width, 4 feet and 20 feet, respectively. The remainder had an average depth of 2 feet.

During the fiscal year ending June 30, 1891, $35,566.02 was expended. The cut was completed, giving a channel 4 feet deep and 20 feet wide at the base, and extending from the 4-foot depth in one bay to that in the other. Three temporary wooden bridges were constructed across the cut at as many public road crossings.

A survey was made during the past winter for an extension of the water-way from Rehoboth Bay to Delaware Bay and to determine the final location. A report on the survey was submitted by the officer in

charge, April 7, 1891, recommending the so-called Stockley Creek route, but in view of the greatly increased estimate of cost, it was decided by the Secretary of War, on the recommendation of this office, to submit the whole matter to Congress before expending the $50,000 appropriated by act of September 19, 1890.

July 1, 1890, balance unexpended	$45,730.74
Amount appropriated by act approved September 19, 1890	50,000.00
	95,730.74
June 30, 1891, amount expended during fiscal year	35,566.02
July 1, 1891, balance unexpended	60,164.72
July 1, 1891, outstanding liabilities	6,014.52
July 1, 1891, balance available	54,150.20
Amount (estimated) required for completion of existing project	231,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 8.)

9. *Susquehanna River, above and below Havre de Grace, Maryland.*—Before improvements were commenced in this section of the river the least depth of water over the shoals between Havre de Grace and Spesutia Island was 5 feet at mean low water. The channel between Watson Island, above Havre de Grace, and the shoal running out from the west shore, was very narrow, and caused many serious ice gorges at and near Port Deposit.

The improvements have been in progress since 1852. The present general project is for a 15-foot low-water channel below Havre de Grace and for the removal of the shoal opposite Watson Island to a depth of 8 feet below mean low water.

The channel below Havre de Grace was dredged the last time in 1885 to a depth of 12 feet; it has shoaled again. The channel west of Watson Island has been widened, by dredging, about 400 feet.

At the close of the fiscal year ending June 30, 1890, the sum of $158,517.75 had been expended on these improvements. The expenditures during the fiscal year ending June 30, 1891, were $169.90.

It is proposed to withhold for the present the appropriation of $4,000, made by the act of September 19, 1890, until the survey of the river above Havre de Grace, ordered by the same act, has been completed and a modified project based upon the results of this survey can be submitted.

July 1, 1890, balance unexpended	$372.25
Amount appropriated by act approved September 19, 1890	4,000.00
	4,372.25
June 30, 1891, amount expended during fiscal year	169.90
July 1, 1891, balance unexpended	4,202.35
Amount (estimated) required for annual dredging	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 9.)

10. *North East River, Maryland.*—North East River is a small tributary of Chesapeake Bay, and joins the latter at the head of the bay, east of the mouth of the Susquehanna River. Its tidal portion is in

Cecil County, Md., and is broad and comparatively shallow and about 5 miles long, the town of North East being at the head of navigation. The average rise of the tide is 2¼ feet. The river is obstructed by a bar about three-fourths of a mile below the town. The original depth on this bar was 18 inches at low water. In 1873 and 1881 a channel was dredged with appropriations of $10,000 and $5,500, respectively, from outside the bar to the wharves, which had a depth of 6 feet at mean low water. Part of this channel at the bar filled in again, reducing the depth to 4 feet. The improvements made were at the time of great benefit to the shipping; the increase in commerce is, however, not appreciable.

The present project for improvement, proposed in a report of a survey made in 1889 and adopted under an appropriation of $2,500, made September 19, 1890, provides for a channel 6 feet deep at mean low water, 75 feet wide across the bar, and 60 feet wide to Davis Wharf at North East.

The estimated cost is $5,140. The sum of $2,393.85 was expended during the past fiscal year in dredging a cut 40 feet wide, 6½ feet deep at mean low water, and 5,700 feet long from outside the bar across the latter to opposite Stony Run.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	106.15
July 1, 1891, balance unexpended	2,393.85
July 1, 1891, outstanding liabilities	2,200.00
July 1, 1891, balance available	193.85
Amount (estimated) required for completion of existing project	2,640.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,640.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix H 10.)

11. *Elk River, Maryland.*—Elk River is a tributary of Chesapeake Bay, and is navigable as far as the town of Elkton, Cecil County, Md. The tide rises 2½ feet.

This river has been under improvement since 1873, when a project was made for a channel 50 or 70 feet wide from Cedar Point to the county bridge, and in Little Elk River to Bennett's Wharf, dredged to a depth of 6 feet below mean low water and for 3,300 feet of diking.

The project was completed in 1884; the result was a channel 80 feet wide through the bar near Cedar Point and 70 feet wide as far as the bridge, with a general depth of 7 feet below mean low water. The original depth, where improved, was 1¼ feet at the shoalest place.

The present project for improvement proposed in a report on a survey made in 1889 and adopted under an appropriation of $10,000 made September 19, 1890, provides for dredging a channel 8 feet deep below mean low water and of a general width of 100 feet, from the county bridge to near the club house opposite Cedar Point, a distance of nearly 3 miles. During the past fiscal year a contract has been entered into for work to the extent of the available appropriation.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	57.82
July 1, 1891, balance unexpended	9,942.18
July 1, 1891, amount covered by uncompleted contracts	8,500.00
July 1, 1891, balance available	1,442.18

Amount (estimated) required for completion of existing project	$14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 11.)

12. *Fairlee Creek, Maryland.*—The original depth at the mouth before improvements were begun was 2 feet at low tide. Inside the creek it was about 5 feet. Navigation was and is still carried on by a few flat-bottomed so-called lime boats and by one small schooner. The existing project is for a 7-foot low-water channel, 100 feet wide across the bar outside the entrance, and within the creek, for a total distance or length of cutting of about 3 miles, the estimated cost being $15,558.

An appropriation of $5,000, made by the river and harbor act of August 11, 1888, the first made for this work, was expended during the year 1889, and a cut was dredged across the bar outside the entrance 80 feet wide, 900 feet long, and of the required depth. At the close of the fiscal year ending June 30, 1890, the sum of $5,000 had been expended. There was no noticeable increase in the very limited commerce of the creek.

The appropriation of $5,000 made September 19, 1890, was expended during the fiscal year ending June 30, 1891, in widening the channel outside the entrance from 80 to 100 feet and in dredging a channel inside the creek about 4,738 feet long, beginning at the mouth, and 50 feet wide, the depth being 7 feet, as projected. The amount expended is $4,884.65. Although the availability of the creek for the purposes of navigation has been greatly increased during the past 2 years there are as yet no signs that indicate any increase in the commerce and navigation.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	4,884.65
July 1, 1891, balance unexpended	115.35
Amount (estimated) required for completion of existing project	5,558.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,558.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 12.)

13. *Chester River, Maryland, from Crumpton to Jones Landing.*—Chester River is a tidal stream 40 miles long, and, following the boundary between Kent and Queen Anne Counties, on the eastern shore of Maryland, flows into Chesapeake Bay. It is navigable for vessels of 6 feet draft for 33 miles. Above that point the minimum depth of water is 3 feet. The tide rises 2.1 feet.

The project for improvement proposed in a report on a survey made in 1889 and adopted under an appropriation of $5,000 made on September 19, 1890, provides for dredging a channel 6 feet deep at mean low water, and 60 feet wide, from Crumpton to a point 1 mile below Millington, at an estimated cost of $12,750. The length of this section of the river is about 6 miles.

A contract for the expenditure of the available funds as proposed has been made and the work is to be completed by May 1, 1892.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	7.65
July 1, 1891, balance unexpended	4,992.35
July 1, 1891, amount covered by uncompleted contracts	4,500.00
July 1, 1891, balance available	492.35

Amount (estimated) required for completion of existing project.....	$7,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,750.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 13.)

14. *Choptank River, Maryland.*—Before improvements were commenced in 1879, the depth of water between Denton and Greensboro varied from 2 to 8 feet at low water. Navigation carried on by small sailing vessels extended to 3 miles above Denton. Above that point and for a distance of 5 miles lighters were used for transporting freight to and from the lower landings.

A project for improvement was made in 1880 for an 8-foot low-water channel, 75 feet wide, at an estimated cost of $79,000. During the 3 years following the projected channel was dredged to a depth of only 6 and 7 feet, on account of the small appropriations and the prevailing high prices for dredging. Since 1885 the originally proposed depth has been made whenever possible and the width restricted to 40 feet.

Up to the close of the fiscal year ending June 30, 1890, the sum of $30,137.62 had been expended in dredging, the least depth in the channel from Denton to Case's Wharf at Greensboro being then 5 feet. This warranted the establishment of a steamboat line with Baltimore for freight, which now runs regularly. During the fiscal year ending June 30, 1891, the sum of $7,376.01 was expended.

The channel was extended 2,400 feet towards the bridge at Greensboro and was deepened to 8 feet at four other points further down the river. The amount of material removed was 47,077 cubic yards. Preparations have been made to expend the appropriation of $7,500, made September 19, 1890, in continuing dredging where the projected channel has not yet been brought to its full dimensions.

The condition of the channel is the same as left at the close of operations in August, 1890, and since it has been deepened there is less detention of vessels by low tides.

July 1, 1890, balance unexpended.....	$7,362.38
Amount appropriated by act approved September 19, 1890.....	7,500.00
	14,862.38
June 30, 1891, amount expended during fiscal year.....	7,376.01
July 1, 1891, balance unexpended.....	7,486.37
July 1, 1891, amount covered by uncompleted contracts.....	6,500.00
July 1, 1891, balance available.....	986.37
Amount (estimated) required for completion of existing project.....	23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 14.)

15. *Cambridge Harbor, Maryland.*—The entrance to this harbor was originally only 4½ feet deep at mean low tide. The average depth in the harbor was about 3 feet; at a few places it was 8 and 9 feet. The bar was impassable during strong northwesterly winds for vessels drawing 3 feet of water. The local commerce was carried on by a limited number of sailing vessels of the smallest class, and by one steamer of light draft. The citizens of Cambridge made an effort previous to 1871 to increase the availability of the harbor, and expended $7,500 in dredging. In that year the General Government commenced the improvement of the harbor under a project which was completed in

1879, a channel 100 feet wide across the bar and portions of the inner harbor having been dredged to a depth of 8 feet below mean low water. During the year 1884 the channel at the bar was slightly widened. At the close of the fiscal year ending June 30, 1888, the sum of $32,500 had been expended by the Government.

A new project based upon a survey made in accordance with the requirements of the act of August 5, 1886, was approved in 1887, for a channel 12 feet deep at low water and 150 feet wide from the Choptank River to the railroad wharf, and for dredging the inner harbor below the draw bridge to 10 feet and above the bridge to 8 feet below low water, at an estimated cost of $17,736.60. At the close of the fiscal year ending June 30, 1890, the sum of $4,918.72 had been expended in the execution of this project. The result was a channel 12 feet deep at low water and about 88 feet wide across the bar to a point opposite the Maryland Steamboat Company's Wharf, and thence only 22 feet wide to the railroad wharf, so that vessels drawing 11½ feet of water, which formerly could not enter at all, can now go directly to the latter wharf without much difficulty.

A project for the application of the appropriation of September 19, 1890, in continuing dredging at the bar and in the harbor below the bridge was approved, but a subsequent request was received from the citizens of Cambridge to have the funds expended above the bridge to give more anchorage ground.

The commissioners of Dorchester County have under consideration the subject of widening the draw in the bridge. When this is done, it is proposed to expend the available funds as requested by the citizens of Cambridge.

July 1, 1890, balance unexpended	$100.00
Amount appropriated by act approved September 19, 1890	5,000.00
	5,100.00
June 30, 1891, amount expended during fiscal year	18.72
July 1, 1891, balance unexpended	5,081.28
Amount (estimated) required for completion of existing project	7,736.60
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,736.60
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 15.)

16. *Wicomico River, Maryland.*—Wicomico River flows through Wicomico County, eastern shore of Maryland, and into Tangier Sound, Chesapeake Bay, from the east. Its tidal estuary is navigable for about 23 miles, Salisbury, the county seat, being at the head of navigation. The tide rises on an average 3 feet. The original depth in the river near Salisbury was 18 inches at the time improvements commenced in 1872. Under a project made that year and completed in 1885, a channel 7 feet deep and 75 feet wide, afterwards increased to 100 feet, was dredged at and below Salisbury and $50,000 was expended. The benefits that navigation and commerce derived from the improvement were quite marked.

The present project for improvement, proposed in a report on a survey made in 1889, and adopted under an appropriation of $10,000 made September 19, 1890, provides for dredging a channel 9 feet deep at mean low water and 150 feet wide from near Fruitland Wharf to the drawbridge at Salisbury, at an estimased cost of $23,200. The length of the proposed channel is about 3 miles. A contract for the expendi-

ture of the available funds has been made, but at the close of the fiscal year operations had not been commenced.

July 1, 1890, balance unexpended	$957.06
Amount appropriated by act approved September 19, 1890	10,000.00
	10,957.06
June 30, 1891, amount expended during fiscal year	42.43
July 1, 1891, balance unexpended	10,914.63
July 1, 1891, amount covered by uncompleted contracts	9,000.00
July 1, 1891, balance available	1,914.63
Amount (estimated) required for completion of existing project	13,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	13,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 16.)

17. *Manokin River, Maryland.*—Manokin River is a tidal tributary of Tangier Sound, Chesapeake Bay, and flows through Somerset County, eastern shore of Maryland. Its length is about 18 miles, the lower 10 miles forming a wide estuary. The channel is interrupted for a distance of nearly 3 miles at the head of the estuary by shallow mud flats which made navigation very difficult, and rendered the upper portion of the river almost useless for the purpose of shipping and transportation. The average rise of the tide at the mud flats is 2.6 feet.

The project for improvement proposed in a report on a survey made in 1889, and adopted under an appropriation of $7,500 made by act of September 19, 1890, provides for dredging a channel 6 feet deep at mean low water, and 100 feet wide from Locust Point to Sharp's Point, embracing the section called "the mud flats," the estimated cost being $30,000.

With this first appropriation a cut was made during the fiscal year ending June 30, 1891, at the section indicated, about 13,515 feet long, 30 feet wide, and 3 feet deep at low water, and $7,360.12 was expended.

Since the opening of this channel the small steamer plying between Princess Anne and Deal's Island has been enabled to make trips at stated hours, which heretofore was impossible, and the reports are that great interest is taken in the new facilities offered to shippers.

Amount appropriated by act approved September 19, 1890	$7,500.00
June 30, 1891, amount expended during fiscal year	7,360.12
July 1, 1891, balance unexpended	139.88
Amount (estimated) required for completion of existing project	22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 17.)

18. *Onancock Harbor, Virginia.*—Onancock Harbor or Onancock River is about 5 miles long and flows into Chesapeake Bay in Accomac County, Virginia. The town of Onancock is situated at the head of the river, where the depth of water was originally 4 feet at low tide. The most serious obstruction is at the bar at the mouth, where the depth in the channel was 5 feet before it was improved. The average rise of the tide is about 2 feet.

Eight thousand dollars was expended during the years 1880 and

1881 and the channel across the bar was dredged to a depth of 8 feet below mean low water for a width of 100 feet and inside the river dredging was done to a depth of 7 feet below mean low water at and above Wise's Point and near the steamboat wharf at Onancock. The improvements made were of great benefit to the shipping on the river, but the channel at the bar soon filled up again.

The present project for improvement, proposed in a report on a new survey made in 1889 and adopted under an appropriation of $6,000 made September 19, 1890, provides for dredging a channel 300 feet wide at the outer bar and 200 feet wide at the inner bar, also called "middle ground," both to a depth of 8 feet below mean low water, at an estimated cost of $12,511.

A contract for the expenditure of the available funds in accordance with this project has been made, but at the close of the fiscal year operations had not yet been commenced.

Amount appropriated by act approved September 19, 1890	$6,000.00
June 30, 1891, amount expended during fiscal year	29.75
July 1, 1891, balance unexpended	5,970.25
July 1, 1891, amount covered by uncompleted contracts	5,250.00
July 1, 1891, balance available	720.25
Amount (estimated) required for completion of existing project	6,511.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,511.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix H 18.)

19. *Harbor at Cape Charles City, Virginia, and approaches by Chenton (Cherrystone) Inlet.*—The harbor of Cape Charles City is an artificial rectangular tidal basin of about 10 acres area, excavated in the shore of the Chesapeake Bay about 12 miles north of the promontory of the peninsula formed by the State of Delaware and the eastern shores of Maryland and Virginia. It is in Northampton County, Va., and forms the shore terminus of the New York, Philadelphia, and Norfolk Railroad, from which transfers of freight and passengers are made to and from Norfolk, Va. The average rise of the tide is 2.6 feet.

The project for improvement proposed in a report on a survey made in 1889 and adopted the past fiscal year under an appropriation of $25,000, made September 19, 1890, provides for dredging the harbor and the entrance to a depth of 14 feet below mean low water and the channel in Cherrystone Inlet and across Cherrystone Bar to a depth of 16 feet at mean low tide, the former to be 100 feet and the latter 200 feet wide; and for protective works of stone at the entrance to the harbor. The estimated cost of the project is $142,340.

The harbor was originally made and inclosed with bulkhead wharves by the railroad company. It was then dredged, together with the entrance as far as Cherrystone Inlet Channel, to a depth of about 12 feet at low tide. This depth was not sufficient for the very large boats and barges employed in the traffic; the entrance was also too narrow and during prevailing northerly winds and low tides frequent delays occurred by the grounding of vessels at the entrance or within the channel across Cherrystone Bar. This was the condition of the harbor and approaches at the close of the fiscal year ending June 30, 1890.

The appropriation of September 19, 1890, was expended during the fiscal year ending June 30, 1891, in dredging about one-half of the area of the harbor to a depth of 14 feet below mean low water, and dredg-

ing the entrance to a depth of 16 feet below mean low water and widening the channel thereat from 50 feet at the outlet of the harbor to 480 feet at the junction with Cherrystone Inlet Channel, and in removing portions of a shoal to the same depth in Cherrystone Inlet about 1 mile south of the harbor.

The amount expended at the close of the fiscal year was $21,676.89. The improvements made have been of great benefit to the shipping and the difficulties encountered in entering or leaving the harbor have been much lessened.

Amount appropriated by act approved September 19, 1890	$25,000.00
June 30,1891, amount expended during fiscal year	21,676.89
July 1, 1891, balance unexpended	3,323.11
Amount (estimated) required for completion of existing project	20,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix H 19.)

20. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the fiscal year ending June 30, 1891, the following wrecks were removed under the provisions of the act of June 14, 1880: The schooner *Maria Green*, from Jackson Creek, Chester River, Maryland, and the schooner *Mary H. Rhoades*, from Smyrna River, Delaware.

(See Appendix H 20.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, W. F. Smith, United States Agent, Major of Engineers, U. S. Army, Retired, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Major Smith, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Linchester River, Maryland.*—Printed as House Ex. Doc. No. 161. (See also Appendix H 21.)

2. *Nanticoke River, Maryland, the northwest fork of the same.*—Printed as House Ex. Doc. No. 163. (See also Appendix H 22.)

3. *Tangier Harbor, Virginia.*—Printed as House Ex. Doc. No. 172. (See also Appendix H 23.)

The required preliminary examination of *Broad Creek River, Delaware*, was made by the local engineer in charge, W. F. Smith, United States Agent, and report thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Major Smith, and of the Division Engineer, based upon the facts and reasons given, that this river is worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The improvement

proposed contemplates enlarging the channel between Laurel and Bethel, Del., to a depth of 8 feet below mean low water and a width of 70 feet, at an estimated cost of $15,000. (See Appendix H 24.)

The required preliminary examinations of the following localities were made by the local engineer in charge, W. F. Smith, United States Agent, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Major Smith, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Major Smith was charged with and has completed their survey and submitted reports thereon.

1. *Turner's Creek, Maryland.*—The improvement proposed contemplates dredging away a portion of the point projecting into the mouth of the creek and the construction of a spur dike 400 feet long near the entrance, at a total estimated cost of $4,060. (See Appendix H 25.)

2. *La Trappe [River], Maryland.*—The improvement proposed contemplates dredging a channel through the bar at the mouth 11 feet deep at mean low water and 150 feet wide, and enlarging the present low-water channel from the mouth to Trappe Landing so that it will be not less than 75 feet wide and 8 feet deep. The cost is estimated at $7,250. (See Appendix H 26.)

3. *Warwick [River], Maryland.*—The improvement proposed contemplates increasing the dimensions of the channel heretofore made by the United States, by deepening and straightening it where necessary, to a width of 100 feet and depth of 10 feet at low water from the Choptank River to the wharves. The estimated cost of this work is $18,600. (See Appendix H 27.)

4. *Broad Creek, Maryland.*—The improvement proposed contemplates the formation of a 7-foot low-water channel 120 feet wide from the 7-foot depth in Pocomoke Sound to the same depth in Little Annemessex River, at an estimated cost of $54,000. (See Appendix H 28.)

The required preliminary examinations of the following localities were made by the local engineer in charge, W. F. Smith, United States Agent, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Major Smith, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Major Smith was charged with their survey, the reports on which will be submitted when received.

1. *Murderkill River, Delaware.*

2. *Mispillion River, Delaware, with a view of cutting a canal so as to shorten the distance to the bay, and making an outlet in the bay which would furnish deeper water.*

3. *Susquehanna River, Maryland, above Havre de Grace.*

4. *Rock Hall Harbor, Maryland.*

IMPROVEMENT OF PATAPSCO RIVER AND CHANNEL TO BALTIMORE, MARYLAND, AND OF JAMES RIVER, VIRGINIA.

Officer in charge, Col. William P. Craighill, Corps of Engineers.

1. *Patapsco River and channel to Baltimore, Maryland.*—The depth of this channel has by successive steps been increased from 17 feet at mean low water to 27 feet, with an average rise of tide of about 18 inches.

The project of improvement first adopted and commenced in October, 1853, had for its object to give a channel 22 feet deep at mean low water with a width of 150 feet.

Little was done before the late war, but afterwards these dimensions were increased, a depth of 24 feet at mean low water being determined upon with a width of channel ranging from 250 to 400 feet.

This channel was completed in 1874, important changes of position having been given to a portion of it, by which the distance was materially lessened and the expense of maintenance decreased.

The object of the improvement was to permit the approach to Baltimore, at mean low water, of vessels drawing from 22½ to 23 feet, and at ordinary high water of vessels drawing 24 and 24½ feet. Later the project had in view a depth of 27 feet at mean low water with a width of 600 feet.

Operations were brought to a close in August, 1889, for want of money and were not resumed in the year ending June 30, 1890. The channel throughout had then been excavated to 27 feet at low water. The Craighill Channel below the Cut-off, the Cut-off Channel, and the Brewerton above the Cut-off had been excavated to 400 feet width. The Fort McHenry division was generally 250 feet in width, except at the upper end, where it is 500. All the angles were much wider, the object being to facilitate the movement of large ships at these turns. The portions of the Brewerton below the Cut-off and of the Craighill above it have not been dredged for years, and are not now considered a part of the channel under improvement by the United States. Their width is about 250 feet and the depth 24 feet.

Up to June 30, 1890, the United States had expended $2,461,997.65, with the result indicated above. The city of Baltimore and the State of Maryland, chiefly the former, have also contributed to the same object more than $500,000. The expenditure up to June 30, 1891, by the United States was $2,561,010.48.

The river and harbor law of September 19, 1890, appropriated $340,000, and the sundry civil law of March 3, 1891, an additional sum of $151,200. The former contained the following important proviso:

> *Provided*, That such contracts as may be desirable may be entered into by the Secretary of War for the completion of the existing project, or any part of same, to be paid for as appropriations may from time to time be made by law.

Operations in carrying out the approved project were resumed as soon as possible after September, 1890, and are now vigorously in progress.

The results of the work in 1891, up to June 30, have been to increase the width of the Brewerton division of the channel from 400 to 550 feet, and also to materially, but not so much, increase the width of the two lower divisions. Nothing has been done in this fiscal year with the Fort McHenry division, as that has been by nature the best part of the channel, and not so much in need of dredging.

Commencing in May, a close resurvey of the Fort McHenry division has been made, and the results plotted.

A thorough survey of the area in the bay east of the lower channel, used for the deposit of dredged material, has been completed as to field work; and a general examination of the whole Patapsco below Fort McHenry is now in progress to ascertain the nature and extent of changes (if any) caused by previous or present deposits of dredged material along or near to the banks of the river.

July 1, 1890, balance unexpended		$45,629.51
Amount appropriated by act approved September 19, 1890		340,000.00
Amount appropriated by sundry civil act approved March 3, 1891		151,200.00
		536,829.51
June 30, 1891, amount expended during fiscal year		99,012.83
July 1, 1891, balance unexpended		437,816.68
July 1, 1891, outstanding liabilities	$3,000.00	
July 1, 1891, amount covered by uncompleted contracts	547,061.54	
		550,061.54
Amount (estimated) required for completion of existing project		208,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		208,800.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I 1.)

2. *James River, Virginia.*—When the improvement of the James River was regularly undertaken by the Government the navigation was obstructed by sunken vessels, by remains of military bridges, and by other obstructions put into the river during the late war to prevent the national fleets from approaching too close to Richmond.

There were also other natural obstructions. Rockett Reef and Richmond Bar had only 7 feet of water at mean low tide. From Warwick Bar to Richmond the channel was crooked and obstructed by dangerous rocks and ledges, the Dutch Gap cut-off was not then open, and the river was in a poor condition as regards its availability for commercial purposes.

The original project of improvement was to secure a depth of 18 feet at full tide (corresponding to about 15 feet at low tide) to Richmond, with a channel width of 180 feet. This project had reached an advanced stage of progress when Congress, by act approved July 5, 1884, adopted the project looking to 22 feet at mean low tide from the sea to Richmond, the width to be 400 feet from the sea to City Point, 300 from thence to Drewry Bluff, and 200 feet from thence to Richmond.

The total amount expended on this river by the United States up to June 30, 1890, was $1,163,677.34, which includes the sum of $432,792.79 expended since the new project was entered upon to give a depth of 22 feet at mean low water. The condition of the river June 30, 1890, was as follows: The practical available draft at high water, from the sea to Curl's Neck, was 19½ feet; thence to Goode Rocks, 18 feet; thence to Richmond, 16½ feet.

The amount expended in the year ending June 30, 1891, has been $57,828.22, and the principal operations of the year have been the following: Widening and deepening the channel near Richmond, from Almond Creek to and at Goode Rocks, deepening and rectifying the channel at Kingsland, the worst point hitherto between Curl's Neck and Warwick Bar; widening the Dutch Gap cut-off; and continuing the survey from Jordan Point to Hog Island, over a distance of nearly 30 miles.

The available draft from the sea to Warwick Bar, which is 5 miles from Richmond, is 19½ feet at high water, being a gain in that depth in a year over the space between Warwick Bar and Curl's Neck, 15½ miles; from Warwick Bar to Goode Rocks, 17 feet; over Goode Rocks, 16½ feet; Goode Rocks to Chesapeake and Ohio wharves, near Richmond, 18 feet. A slight filling of sand has occurred over a space about 250 feet long at Goode Rocks, diminishing the available draft there by 1 foot. This can be readily rectified. Still further improve-

ment in depth and width near Richmond is expected under contracts now in force.

When the proposed improvement is completed an annual expenditure of $20,000 will be necessary for the maintenance of the channel.

The law of September 19, 1890, authorized the expenditure of $3,000, in the discretion of the Secretary of War, in removing the bar at the mouth of Turkey Island Creek or Bayou. The local engineer, after examination of the subject, reported that in his opinion the expenditure mentioned would effect no useful result, and that the improvement to be of real value would cost $25,000. The Chief of Engineers and the Secretary of War concurred in this opinion.

July 1, 1890, balance unexpended		$785.87
Amount appropriated by act approved September 19, 1890		200,000.00
		200,785.87
June 30, 1891, amount expended during fiscal year		57,828.22
July 1, 1891, balance unexpended		142,957.65
July 1, 1891, outstanding liabilities	$2,000.00	
July 1, 1891, amount covered by uncompleted contracts	107,693.83	
		109,693.83
July 1, 1891, balance available		33,263.82
Amount (estimated) required for completion of existing project		3,736,070.45
Amount that can be profitably expended in fiscal year ending June 30, 1893		400,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I 2.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Patapsco River, Maryland, from the Craighill channel to the sugar refinery wharves, Curtis Bay,* was made by the local engineer in charge, Colonel Craighill, and report thereon submitted. It is the opinion of Colonel Craighill, based upon the facts and reasons given, that the locality is worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The cost of dredging a channel 150 feet wide at bottom and 25 feet deep at mean low water from the main ship channel is estimated at $25,000. A channel of the same width, but 27 feet deep at mean low water, which is the depth of the main ship channel, is estimated to cost $85,000. The report was transmitted to Congress and printed as House Ex. Doc. No. 102, Fifty-first Congress, second session. (See also Appendix I 3.)

IMPROVEMENT OF POTOMAC RIVER AND ITS TRIBUTARIES, OF HARBOR AT BRETON BAY, MARYLAND, AND OF CERTAIN RIVERS ON WESTERN SHORE OF CHESAPEAKE BAY, MARYLAND AND VIRGINIA.

Officer in charge, Lieut. Col. Peter C. Hains, Corps of Engineers, with Lieut. George A. Zinn, Corps of Engineers, under his immediate orders since April 6, 1891

1. *Potomac River at Washington, District of Columbia.*—Before the commencement of this improvement the channel to Georgetown, D. C., was narrow and crooked, and had not sufficient depth to meet the needs

of commerce. Vessels drawing 16 feet frequently grounded at high tide above Long Bridge, and frequent dredging was necessary to maintain even this depth. The channel was narrow, as the appropriations for dredging were too small to provide for more than a narrow cut through the bar. The Washington channel was narrow and shoal, and inadequate to the wants of commerce. Extensive mud flats existed along the city front from Observatory Hill to a point opposite the Arsenal. Below Long Bridge these flats were separated from the city front by the Washington channel. The greater portion of these flats was exposed at low tide, and covered at high tide by water polluted by the sewage of the city. At the foot of Seventeenth street, N.W., a large sewer discharged directly upon the flats. These conditions rendered a portion of the city almost uninhabitable.

The average rise and fall of tide in the Potomac River at Washington is 3 feet.

By act passed August 2, 1882, Congress adopted a project which has for its object the improvement of the navigation of the river by widening and deepening its channels; the reclamation or filling of the marshes or flats on the city front, by depositing on them the material dredged from the channels; and the establishment of harbor lines beyond which no wharves or obstructions should be built. The project provides in detail for such depth of channels as will accommodate the largest vessels that can reach Arsenal Point, with such depth at the wharves as will allow vessels to receive full cargoes without grounding at low water: for filling the flats above Long Bridge to a height of 3 feet above the flood line of 1877, and the middle part of the flats below Long Bridge to the same height, but sloping each way to a height of 6 feet above low tide at the margin of the fill; that in order to purify the water in the Washington channel, which will be cut off at its upper end from the Virginia or main channel, a tidal reservoir or basin be established above Long Bridge, to be filled with water from the Virginia channel on the flood tide, and discharged into the Washington channel on the ebb.

The plan also contemplates the rebuilding of Long Bridge, with longer spans and fewer piers, during the progress of the work, and the interception of all sewage now discharged into the Washington channel and its conveyance to James Creek, but neither the reconstruction of the bridge nor the building of the intercepting sewer were included in the estimate of the cost of the improvement.

The estimated cost of the improvement is $2,716,365.

Appropriations have been made as follows:

Act of August 2, 1882	$400,000
Act of July 5, 1884	500,000
Act of August 5, 1886	375,000
Act of August 11, 1888	300,000
Act of September 19, 1890	280,000
Total	1,855,000

Twenty thousand dollars of the appropriation of September 19, 1890, was made available for dredging in the Eastern Branch. About that amount will be expended at that locality, which leaves the aggregate appropriations for the Potomac proper, $1,835,000.

Up to the close of the fiscal year 1890, the expenditures aggregated $1,561,705.50, and the following work had been accomplished: The Virginia channel above Long Bri ge had been deepened to 20 feet at low tide for a width of from 400 to 550 feet, a part of which has since filled up

and been redredged. The same channel below Long Bridge had been dredged to a depth of 20 feet and a width of about 350 feet. This part of the Virginia channel has maintained itself to the full depth originally dredged or has deepened. The Washington channel has been dredged to a depth of 20 feet for a width of 350 feet throughout its entire length, and to a depth of 12 feet from the 20-foot channel nearly to the easterly margin of the fill up as far as the Seventh street wharf. This channel has for the most part maintained itself, though some filling occurred during the freshet of June, 1889. All the material dredged from the river had been deposited on the flats, and of the 12,000,000 cubic yards estimated to be required, about 8,301,000 had been deposited. The entire area of the flats, about 621 acres, had been outlined, the margins or embankment protected as far as practicable by riprap, and practically the entire area to be reclaimed had been raised above overflow at ordinary high tide. The outlet gates of the tidal reservoir at the head of the Washington channel had been completed with the exception of the coping.

The expenditures during the fiscal year 1891 amounted to $65,115.87. This sum was applied to the construction of a sea wall to protect the banks from erosion by waves and currents, about 5,100 linear feet having been completed, and to raising the embankments around the margin of the flats to prevent their overflow by freshets. The construction of a dike on the westerly side of the Virginia channel, above Long Bridge, with a view to reducing the deposit at that locality, has also been in progress.

Contracts have been made for dredging in the Virginia channel, in the Eastern Branch, and in the Washington channel. The latter work is now in progress, and will complete the dredging to be done in the Washington channel. The work in the Eastern Branch is under the provisions of the river and harbor act of September 19, 1890, which makes $20,000 of the $280,000 appropriated for improving the Potomac River, available for dredging in the Eastern Branch.

The officer in charge refers to the necessity for a liberal appropriation, and gives it as his opinion that though the work has been damaged by freshets, it can still be completed within the estimated cost if a single large appropriation be made.

Long Bridge.—Lieutenant Colonel Hains refers in his report to the necessity of rebuilding Long Bridge. In the event of a freshet occurring when the Potomac River is full of ice, great damage is to be expected. The piers of the bridge are of such faulty construction that an ice gorge would be probable, which would cause the water to back up and overflow portions of the city front, and, through the sewers above the bridge such of the lower parts of the city as may be drained by them. Great damage was done by the freshet of June, 1889, but greater damage may occur from a freshet of lesser magnitude if accompanied by an ice gorge.

July 1, 1890, balance unexpended		$13,294.50
Amount appropriated by act approved September 19, 1890		280,000.00
		293,294.50
June 30, 1891, amount expended during fiscal year		65,115.87
July 1, 1891, balance unexpended		228,178.63
July 1, 1891, outstanding liabilities	$16,775 44	
July 1, 1891, amount covered by uncompleted contracts	170,620.65	
		187,396.09
July 1, 1891, balance available		40,782.54

Amount (estimated) required for completion of existing project	$881,365.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	881,365.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 1.)

2. *Potomac River at Mount Vernon, Virginia.*—Before this improvement was commenced, the ruling depth over the wide flat between the main channel of the Potomac River and the wharf at Mount Vernon was but 4 feet at low tide. The original project, adopted in 1879, was for a channel 150 feet wide, and from 6 to 7 feet deep, with a turning basin at the wharf of 150 feet radius. This project was amended in 1888 so as to provide for a channel 200 feet wide, and a turning basin of 200 feet radius. On June 30, 1890, $14,500 had been expended, and the channel was about 140 feet wide between the 6-foot curves, and from 60 to 100 feet wide between the 9-foot curves, the depth here varying from 9 to 12 feet. The turning basin was 360 feet wide, but was incomplete. The act of September 19, 1890, provided for the completion of the improvement, and operations have been conducted with this end in view.

During the fiscal year ending June 30, 1891, $2,500 was expended. The channel was dredged 165 feet wide, with a depth of from 8 to 10 feet, and the turning basin completed, the radius being 180 feet. The officer in charge regards the present dimensions of the channel as sufficient for navigation, and no further appropriations are recommended.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	1,997.14
July 1, 1891, balance unexpended	502,86
July 1, 1891, outstanding liabilities	502,86

(See Appendix J 2.)

3. *Occoquan Creek, Virginia.*—Occoquan Creek is a tributary of the Potomac River, which it enters about 25 miles below Washington, D. C. Navigation was obstructed by four bars, which were improved between 1873 and 1880 by the expenditure of four appropriations aggregating $25,000, giving a navigable depth of about 6 feet to Occoquan, the head of navigation, 4 miles above the mouth. In compliance with the provisions of the river and harbor act of August 11, 1888, a new survey was made in 1889, and the condition of the several bars found as follows:

Lower Mud, about 3.5 miles below Occoquan. This bar is about 4,000 feet long and had a ruling depth of about 3 feet. The former dredged channel had filled in.

Upper Mud, about 2.25 miles below Occoquan. The channel dredged in 1874–'75 was found to have maintained its original dimensions, being about 50 feet wide and from 5 to 6 feet deep.

Sand Bar, about one-half mile below Occoquan. The former dredged channel had filled in, the least depth being 4.2 feet.

Occoquan Bar, a short bar opposite Occoquan. The channel dredged here had filled in, and the least depth was 4 feet.

The project for the new improvement comprises the dredging of channels 6 feet deep and from 100 to 150 feet wide through the bars, with the construction of such dikes as may be required to maintain the depth secured by dredging. The first appropriation for the new work was made September 19, 1890. At the close of the fiscal year $1,605.01 had been expended. The dredging of a channel 6 feet deep and 100 feet wide through the lower bar was then in progress.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		1,605.09
July 1, 1891, balance unexpended		8,394.91
July 1, 1891, outstanding liabilities	$150.00	
July 1, 1891, amount covered by uncompleted contracts	4,345.36	
		4,495.36
July 1, 1891, balance available		3,899.63
Amount (estimated) required for completion of existing project		35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix J 3.)

4. *Aquia Creek, Virginia.*—Aquia Creek is a tributary of the Potomac River, which it enters about 41 miles below Washington, D. C. The stream is about 7 miles long, and in 1872 its navigation was chiefly obstructed by shoals between the mouth and the "Narrows," 4.5 miles above. Here the creek takes the character of a wide bay, from 1,000 to 6,000 feet wide, while the depths of water ranged from 2 to 4 feet over an almost continuous shoal of soft mud. Above the "Narrows" the creek is from 60 to 200 feet wide, with a depth of from 2 to 17 feet, the shoaler portions being near the head of navigation. The stream is crossed by a bridge of the Richmond, Fredericksburg and Potomac Railroad about 3 miles above the mouth, the draw of the bridge being but 28 feet wide.

From 1872 to 1878 appropriations amounting to $10,000 were made by Congress, and the navigation improved by dredging a channel from 40 to 50 feet wide, and from 4 to 5 feet deep, through the shoaler parts of the creek, chiefly above the railroad bridge.

A new survey of the creek was provided for in the river and harbor act of August 11, 1888, and was made in 1889. The channel dredged from 1872 to 1878 was found to have maintained its dimensions between the railroad bridge and the "Narrows," but at other places it had filled in. The general depth of water in the creek remained substantially as in 1872. Estimates for improving the navigation were submitted January 18, 1890, and an appropriation of $10,000 made by the river and harbor act of September 19, 1890.

The project for the improvement, approved December 4, 1890, proposes a channel 80 feet wide and 6 feet deep, dredged through the shoals where less than 6 feet is found between the mouth of the creek and the "Narrows."

At the close of the fiscal year ending June 30, 1891, $500 had been expended. A channel 80 feet wide and 6 feet deep had then been dredged from Thorny Point, at the lower end of the shoal, for a distance of about 2,670 feet toward the railroad bridge.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		500.00
July 1, 1891, balance unexpended		9,500.00
July 1, 1891, outstanding liabilities	$150.00	
July 1, 1891, amount covered by uncompleted contracts	6,250.00	
		6,400.00
July 1, 1891, balance available		3,100.00
Amount (estimated) required for completion of existing project		30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix J 4.)

5. *Harbor at Breton Bay, Maryland.*—The navigation of the head of Breton Bay was obstructed in 1874 by a shoal extending from the 9-foot curve in the bay to Leonardtown, a distance of about 1 mile, the least depth on the shoal being 5 feet at low tide. The original project, adopted in 1878, contemplated dredging a channel 150 feet wide and 9 feet deep through the shoal with a suitable turning basin at the wharf. In 1885 the project was amended to provide for a channel 200 feet wide and 10 feet deep, with a turning basin 400 feet wide by 800 feet long. In 1890 the original project was resumed, as this appeared to be sufficient for the navigation of the bay. At the close of the fiscal year ending June 30, 1890, $32,500 had been expended. The condition of the improvement at the close of the last preceding dredging operations (in March, 1889) was as follows: The basin at the Leonardtown Wharf was 645 feet long by 370 feet wide. From the lower end of the basin the channel was 150 feet wide for a distance of 1,870 feet, and for a further distance of 1,380 feet around the turn at Buzzard Point, the width varied from 185 to 280 feet. The depths varied from 8.5 to 14.6 feet. The channel between Buzzard Point and the 9-foot curve in Breton Bay had not been dredged.

During the fiscal year ending June 30, 1891, $517.79 were expended, and at the last-named date the dredging needed to complete the project was in progress. No further work is required by navigation at present, and no further appropriations are recommended.

Amount appropriated by act approved September 19, 1890		$5,000.00
June 30, 1891, amount expended during fiscal year		517.79
July 1, 1891, balance unexpended		4,482.21
July 1, 1891, outstanding liabilities	$200.00	
July 1, 1891, amount covered by uncompleted contracts	3,000.00	
		3,200.00
July 1, 1891, balance available		1,282.21

(See Appendix J 5.)

6. *Nomini Creek, Virgina.*—This stream is an important tributary of the Potomac, which it enters about 82 miles below Washington, D. C.

Navigation was obstructed in 1872 by a bar of sand and oyster shells at its mouth, over which but 3 feet could be carried at low tide, and the dangers and difficulties of passing the bar were further increased by a rapid current and cross tides. After passing the bar 8 feet can be carried to Nomini Ferry, about 4 miles above the mouth.

The original project for the improvement, adopted in 1873, provided for dredging a channel 100 feet wide and 9 feet deep through the bar. The project was modified in 1879 by increasing the width to 150 feet, and again in 1885 by increasing the width to 200 feet. In 1890 a further modification was made, proposing the construction of two jetties parallel to the outer channel, retaining the width of dredging at 150 feet. The total cost of this modified project was placed at $72,500. Up to June 30, 1890, $36,986.61 had been expended. At the close of work in 1883 a channel about 100 feet wide and 9 feet deep had been dredged through the bar. During the suspension of work, from 1883 to 1889, the cut was reduced in depth and width by deposits of sand. In 1889 the outer channel was widened and redredged on the westerly side for a width of 94 feet and a length of 1,470 feet, the depths being from 8.9 to 13.8 feet.

During the fiscal year ending June 30, 1891, $2,961.28 has been expended in dredging the channel at and outside of White Point, the

width attained being from 130 to 150 feet, and the depth 9 feet. A rip-rap dike was built inside White Point, to check the cross tidal current.

July 1, 1890, balance unexpended		$513.39
Amount appropriated by act approved September 19, 1890		5,000.00
		5,513.39
June 30, 1891, amount expended during fiscal year		2,961.28
July 1, 1891, balance unexpended		2,552.11
July 1, 1891, outstanding liabilities	$150.00	
July 1, 1891, amount covered by uncompleted contracts	1,768.05	
		1,918.05
July 1, 1891, balance available		634.06
Amount (estimated) required for completion of existing project		30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix J 6.)

7. *Patuxent River, Maryland.*—The present head of navigation on the Patuxent River is Bristol, Maryland, about 46 miles above the mouth. Prior to the commencement of the improvement navigation below Bristol was obstructed by two bars, (1) Swann Point Bar, about 43 miles above the mouth, having a least depth of 7.8 feet, and (2) Bristol Bar, at Bristol, having least depths in front of the two wharves of 7.6 and 4.2 feet. Two other bars below, viz, Pope Shoal (24 miles above the mouth), and Warren Reach Bar (34 miles above the mouth), were mentioned in the report of the preliminary examination as worthy of survey, but they offer no obstruction to the present standard of navigation.

The original project was adopted in 1888, and contemplated dredging a cut 200 feet wide and from 12 to 13 feet deep through Swann Point Bar and Bristol Bar, so as to give when completed a channel about 100 feet wide and 12 feet deep at low tide. This project was modified in 1890 so as to provide for a channel 120 feet wide and 12 feet deep (then already dredged), at Bristol Bar, and a channel about 100 feet wide and 9 feet deep at Swann Point Bar, these last-named dimensions being regarded as sufficient for the present and immediately prospective demands of commerce.

At the close of the fiscal year ending June 30, 1890, $5,000 had been expended, and a channel 120 feet wide, 12 feet deep, and 794 feet long had been dredged at Bristol Bar.

During the fiscal year ending June 30, 1891, $4,816.66 has been expended in dredging a channel 9 feet deep, about 100 feet wide, and about 2,250 feet long through Swann Point Bar.

This work completes the existing project, unless it should appear from future examinations that works of contraction are needed to maintain the channel at Swann Point Bar. At the present time no further appropriations are recommended.

July 1, 1890, balance unexpended	$1.50
Amount appropriated by act approved September 19, 1890	6,000.00
	6,001.50
June 30, 1891, amount expended during fiscal year	4,816.66
July 1, 1891, balance unexpended	1,184.84
July 1, 1891, outstanding liabilities	150.00
July 1, 1891, balance available	1,034.84

(See Appendix J 7.)

8. *Rappahannock River, Virginia.*—The obstructions to navigation of the Rappahannock River, before improvement, were nine bars between Tappahannock, 41 miles above the mouth, and Fredericksburg, 106 miles above the mouth, over which the ruling depths were from 4 to 10.5 feet. The chief obstructions were in the 12.5 miles of river below Fredericksburg, where seven of the bars are found. Of these bars, Fredericksburg Bar, with a least depth of 4 feet, and Spottswood Bar, 4 miles below Fredericksburg, with a least depth of 6 feet, caused the most delay to steamboats and vessels.

The original project, adopted in 1871, proposed a channel 10 feet deep and 100 feet wide through all the bars. This was modified in 1879 by increasing the dimensions of the channel between Port Royal and Tappahannock to 15 feet in depth and 200 feet in width, to accommodate the larger class of vessels.

Up to June 30, 1890, $108,421.30 had been expended, and depths of from 8 to 9.5 feet secured through the bars between Fredericksburg and Port Royal by dredging and the construction of dikes. Wrecks and snags obstructing navigation had also been removed.

During the fiscal year ending June 30, 1891, $3,364.94 has been expended. The dikes at Fredericksburg, Pollock, Bernard, Spottswood, and Castle Ferry bars have been repaired. A new plant for building and repairing dikes and for snagging on the Rappahannock, Mattaponi, and Pamunkey rivers has been nearly completed. A contract for dredging at Fredericksburg Bar has been made, work to be commenced July 15, 1891.

July 1, 1890, balance unexpended		$2,527.77
Amount appropriated by act approved September 19, 1890		15,000.00
		17,527.77
June 30, 1891, amount expended during fiscal year		3,364.94
July 1, 1891, balance unexpended		14,162.83
July 1, 1891, outstanding liabilities	$2,419.67	
July 1, 1891, amount covered by uncompleted contracts	8,024.88	
		10,444.55
July 1, 1891, balance available		3,718.28
Amount (estimated) required for completion of existing project		164,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix J 8.)

9. *Urbana Creek, Virginia.*—Urbana Creek is a tributary of the Rappahannock River, which it enters 16 miles above the mouth. Before improvement navigation was obstructed by a bar outside the mouth, over which but 6.5 feet could be carried, and a shoal within the creek having a least depth of 7 feet.

The original project adopted in 1879 provided for dredging a channel 150 feet wide and 10 feet deep through the outer bar. This project was extended in 1883 so as to include dredging to 10 feet through a shoal within the creek near the town of Urbana.

Up to the close of the fiscal year ending June 30, 1890, $18,500 had been expended. The channel through the outer bar had been dredged to a depth of 10 feet and a width of 140 feet, but owing to the action of storms the width had decreased from sand filling to 90 feet. A channel had also been dredged through the shoal within the creek from 80 to 170 feet wide and 10 feet deep, and dikes and jetties had been built

along the sand spit to check the movement of sand, which tends to close the natural channel at the end of the spit.

In the river and harbor act approved September 19, 1890, an appropriation of $3,000 was made for continuing the improvement. A contract was made for dredging at and near the sand spit, work to be commenced September 15, 1891. Jetties will be also constructed along the beach on the outer side of the spit, this work to be done by hired labor.

Amount appropriated by act approved September 19, 1890		$3,000.00
July 1, 1891, balance unexpended		3,000.00
July 1, 1891, outstanding liabilities	$100.00	
July 1, 1891, amount covered by uncompleted contracts	1,987.50	
		2,087.50
July 1, 1891, balance available		912.50
Amount (estimated) required for completion of existing project		13,080.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		13,080.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix J 9.)

10. *York River, Virginia.*—The Pamunkey and Mattaponi rivers unite at West Point, Va., to form the York River, which is 41 miles in length, and empties into Chesapeake Bay about 16 miles above Old Point, Va. Prior to the commencement of the improvement navigation was obstructed by Potopotank Bar, 9 miles below West Point, on which the ruling depth was 18.5 feet; by West Point Bar, extending about 2 miles below West Point, and having a ruling depth of 15.5 feet; and by shoal water in front of the West Point wharves, at the mouth of the Pamunkey.

The original project provided for a channel 22 feet deep and 200 feet wide through these bars, with an increased width at the wharves. In 1884 the proposed channel width was increased to 400 feet, and in 1887 the project was amended so as to include the construction of a dike along the flats on the right of the channel, to contract the waterway and maintain the depth dredged, which had decreased from continued silting.

Up to the close of the fiscal year ending June 30, 1890, $127,489.27 had been expended in the following work: A channel 105 feet wide and 22 feet deep was dredged in 1880–'81 through Potopotank Bar, which had, however, shoaled in 1890 to from 20.8 to 21.7 feet. A channel 22 feet deep and from 161 to 257 feet wide, with a center cut 24 feet deep and 40 feet wide, had been dredged at West Point Bar, the ruling depth in January, 1890, being 20.6 feet.

An appropriation of $30,000 was made in the river and harbor act of September 19, 1890, for continuing the improvement. A contract was made March 9, 1891, with the Baltimore Dredging Company for dredging material from the channel and depositing it in an embankment on the flats, so as to form a dike and contract the river channel. The contract price for this work was $14\frac{7}{8}$ cents per cubic yard. Owing to the soft character of the material forming the flats the contractors were unable to form the embankment with the plant at their command, and after several weeks of unsuccessful work requested that their contract be modified so as to provide for dredging in the channel and dumping at other dumping grounds to be provided by them at 9 cents per cubic yard, stating that they had already been at large expense and had accomplished practically nothing. The proposed price was regarded as reasonable, and as channel dredging was required at once to accommodate the cotton shipments of the current year, and the proposed modifi-

cation would render about $10,000 available for the construction of a timber dike, it was thought advisable, in view of all the circumstances, to modify the contract. A supplemental agreement was accordingly made on May 11, 1891, and work thereunder commenced June 10, 1891. On June 30, 1891, a cut 80 feet wide and 22 feet deep had been made in front of the West Point wharves.

An examination of the West Point channel shows that the shoaling continues, and that the ruling depth is now but 18 feet. Under the present appropriation the shoaler parts of this channel will be re-dredged, and the construction of the dike commenced.

July 1, 1890, balance unexpended		$1,300.73
Amount appropriated by act approved September 19, 1890		30,000.00
		31,300.73
June 30, 1891, amount expended during fiscal year		2,420.90
July 1, 1891, balance unexpended		28,879.83
July 1, 1891, outstanding liabilities	$500.00	
July 1, 1891, amount covered by uncompleted contracts	15,300.00	
		15,800.00
July 1, 1891, balance available		13,079.83
Amount (estimated) required for completion of existing project		150,050.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix J 10.)

11. *Mattaponi River, Virginia.*—The Mattaponi River is navigable for small steamers from its mouth at West Point, Va., to Ayletts, Va., a distance of about 52 miles, and can be made navigable for barges for about 26 miles above Ayletts to Munday Bridge. The obstructions to 5½-foot navigation are five bars below Ayletts, having ruling depths of from 2.5 to 3.6 feet, and wrecks, snags, logs, and overhanging trees. There were eight bars reported above Ayletts, but no improvement of them is proposed.

The approved project adopted in 1880 provides for a channel 40 feet wide and 5.5 feet deep through the bars below Ayletts, and the removal of logs, snags, overhanging trees, wrecks, etc., as far up as Munday Bridge.

Up to the close of the fiscal year ending June 30, 1890, $16,309 had been expended in removing snags, wrecks, logs, and other obstructions between Robinson Bar and Munday Bridge, a distance of 34 miles, and in building 2,226 linear feet of dike at Robinson Bar. The appropriation of $3,000, made September 19, 1890, was too small to be applied to dredging operations, and will be used in removing snags, leaning trees, etc., which again obstruct navigation. The plant formerly used for this purpose on the Rappahannock, Pamunkey, and Mattaponi rivers having become worn out, the construction of a new plant became necessary. At the close of the fiscal year this plant was nearly completed, and snagging operations will be commenced during the present working season (1891).

July 1, 1890, balance unexpended		$3.11
Amount appropriated by act approved September 19, 1890		3,000.00
		3,003.11
July 1, 1891, outstanding liabilities	$50.00	
July 1, 1891, amount covered by uncompleted contracts	1,532.44	
		1,582.44
July 1, 1891, balance available		1,420.67

Amount (estimated) required for completion of existing project	$20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 11.)

12. *Pamunkey River, Virginia.*—The Pamunkey River has a navigable length of 59 miles, and empties into the York River at West Point, Va. Navigation was originally obstructed by five bars in the upper part of the river, and by snags, logs, and overhanging trees.

The project was adopted in 1880 and amended in 1885, and provides for channels 100 feet wide and 7 feet deep through Spring Bar and Skidmore Bar, or to a distance of 47 miles above West Point, and channels 40 feet wide and from 3 to 5 feet deep through the bars above, together with the removal of logs, snags, wrecks, and overhanging trees. On June 30, 1890, logs, snags, etc., had been removed from 22.5 miles of the river between Garlick's Ferry and Hanovertown; dikes had been built at Spring Bar and Skidmore Bar, and a channel 95 feet wide and from 6 to 7 feet deep, dredged through the last-named bar. The amount expended to June 30, 1890, was $18,500. An appropriation of $3,000 was made September 19, 1890, which will be applied to the removal of snags, trees, and similar obstructions, which are annually renewed by freshets. The plant formerly used for this work having become worn out and useless, it became necessary to construct a new one. It is now nearly complete, and it is expected that the snagging operations will be commenced in July, 1891.

July 1, 1890, balance unexpended		$16.36
Amount appropriated by act approved September 19, 1890		3,000.00
July 1, 1891, balance unexpended		3,016.36
July 1, 1991, outstanding liabilities	$50.00	
July 1, 1891, amount covered by uncompleted contracts	1,532.44	
		1,582.44
July 1, 1891, balance available		1,433.92

Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J 12.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Hains, and reports thereon submitted. It is the opinion of Lieutenant-Colonel Hains, based upon the facts and reasons given, that these localities are not worthy of improvement. This opinion being concurred in by me, no further surveys were ordered.

1. *St. Leonard's Creek, Maryland.*—Report transmitted to Congress and printed as House Ex. Doc. No. 120, Fifty-first Congress, second session. (See also Appendix J 13.)

2. *St. Jerome Bay, Maryland.*—(See Appendix J 14.)

3. *Piscataway Creek, Maryland.*—Report transmitted to Congress and printed as House Ex. Doc. No. 49, Fifty-first Congress, second session. (See also Appendix J 15.)

4. *Newport Creek, head of Wicomico River, Charles County, Maryland.*—Report transmitted to Congress and printed as House Ex. Doc. No. 169, Fifty-first Congress, second session. (See also Appendix J 16.)

5. *Smith's Creek, Maryland.*—(See Appendix J 17.)

6. *Nandua Creek, Virginia.*—Report transmitted to Congress and printed as House Ex. Doc. No. 290, Fifty-first Congress, second session. (See also Appendix J 18.)

7. *Potomac Creek, Virginia.*—Report transmitted to Congress and printed as House Ex. Doc. No. 17, Fifty-first Congress, second session. (See also Appendix J 19.)

8. *Upper Machodoc Creek, Virginia.*—Report transmitted to Congress and printed as House Ex. Doc. No. 63, Fifty-first Congress, second session. (See also Appendix J 20.)

9. [*Great*] *Wicomico River, Virginia.*—(See Appendix J 21.)

10. *Crane's Creek, Virginia.*—(See Appendix J 22.)

11. *Piscataway Creek, Virginia.*—Report transmitted to Congress and printed as House Ex. Doc. No. 59, Fifty-first Congress, second session. (See also Appendix J 23.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Hains, and reports thereon submitted. It is the opinion of Lieutenant-Colonel Hains, based upon the facts and reasons given, that these localities are worthy of improvement. This opinion being concurred in by me, Lieutenant-Colonel Hains was charged with their survey, the reports on which will be submitted when received.

1. *Eastern Branch of the Potomac River, including that portion in District of Columbia.*

2. *Potomac River, Virginia and Maryland, up to the city of Washington, with the view of removing obstructions and deepening the channel.*

EXAMINATION AND SURVEY, TO COMPLY WITH REQUIREMENTS OF ACT APPROVED MARCH 3, 1891.

Lieutenant-Colonel Hains was charged with the examination and survey *for a breakwater to form a harbor of safety and refuge in Lynnhaven Bay, near Cape Henry, at the foot of Chesapeake Bay, Virginia*, under the provisions of the act of Congress approved March 3, 1891. The reports will be submitted when received.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN SOUTHEASTERN VIRGINIA AND NORTHEASTERN NORTH CAROLINA.

Officer in charge, Capt. G. J. Fiebeger, Corps of Engineers; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Harbor of Norfolk and its approaches, Virginia.*—The project for improvement adopted in 1877 was to deepen and widen the channel at the mouth of the Southern Branch and along the Berkley and Portsmouth Flats, in the harbor proper, and for the approaches to dredge a channel 500 feet wide and 25 feet deep, at ordinary low water, through the bars at the Western Branch and Sewall Point.

The revised project of 1885 is as follows: (1) To secure a channel not less than 25 feet deep and 500 feet wide at ordinary low water, by dredging from the deep water of Hampton Roads to Norfolk and the United States Navy-yard on the Southern Branch, and also to secure a channel in the Eastern Branch at the same stage, not less than 22 feet

deep, with a width at least 300 feet at the Norfolk and Western Railroad Bridge, and gradually increasing to about 700 feet at its mouth, by dredging between said points; and (2) to ultimately dredge the entire area bounded by lines parallel to and 75 feet from the port-warden lines to a depth not less than 25 feet at ordinary low water, from Fort Norfolk to the United States Navy-yard, and not less than 22 feet from the mouth of the Eastern Branch to Campostella Bridge, and to construct a bulkhead at Berkley Flats.

With slight modifications, all operations have been conducted in accordance therewith.

The amount expended to June 30, 1890, was $482,996.10, which resulted in a channel at least 250 feet wide and 25 feet deep from Hampton Roads to Norfolk Harbor; a channel of the same depth and 125 to 500 feet wide in the Southern Branch to the United States Navy-yard, and a channel 22 feet deep and 200 feet wide in the Eastern Branch to the Norfolk and Western Railroad Bridge.

The channel thus dredged was in a good condition August 1, 1889, except at the mouth of the Eastern Branch, where the depth was 20 feet.

To accommodate the great increase in shipping since 1885, the river and harbor act of September 19, 1890, directs that

> Fifty thousand dollars * * * shall be expended in improving the approach to the inner harbor and the United States Navy-yard at Norfolk, by increasing anchorage between Lambert's Point and Fort Norfolk.

The total estimated cost of a suitable anchorage is $150,000, and this amount has therefore been added to the original estimates.

Under the appropriation of September 19, 1890, a contract was made March 13, 1891, with the National Dredging Company, of Wilmington, Del., to remove about 1,250,000 cubic yards of material before May 30, 1892. Under this contract 273,022 cubic yards of material had been removed from the bar at Sewall Point on June 30. The channel has been increased in width from 250 to 350 feet, with a depth of 25 feet.

During the fiscal year there was expended $15,719.54, which was applied to payments on contract, office expenses, care of property, etc.

July 1, 1890, balance unexpended	2,003.90
Amount appropriated by act approved September 19, 1890	150,000.00
	152,003.90
June 30, 1891, amount expended during fiscal year	15,719.54
July 1, 1891, balance unexpended	136,284.36
July 1, 1891, amount covered by uncompleted contracts	121,612.00
July 1, 1891, balance available	14,672.36
Amount (estimated) required for completion of existing project	457,744.56
Amount that can be profitably expended in fiscal year ending June 30, 1893	191,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K 1.)

2. *Approach to Norfolk Harbor and the United States (Norfolk) Navy-yard between Lambert Point and Fort Norfolk.*—The original condition of this channel was good with the exception of the shoal opposite the mouth of Western Branch, over which there was a navigable depth of 19 feet at ordinary low water.

The project of 1878 was to dredge a channel 500 feet wide and 25 feet deep at ordinary low water the entire length of the shoal, 4,800 feet.

The revised project of 1886 is: (1) To secure a channel not less than

25 feet deep and 500 feet wide at ordinary low water from Lambert Point to Fort Norfolk by the construction of a dike and by dredging. (2) To ultimately widen this channel to within 75 feet of a straight line drawn from Fort Norfolk to the deep water opposite Lambert Point, 6,800 feet of which is the proposed port-warden line, making the channel at least 700 feet wide.

From July 5, 1884, to June 30, 1890, there was expended on this improvement $167,184.34, which resulted in a channel 700 feet wide and 25 feet deep at ordinary low water, and a channel of the same depth and 600 feet wide from the deep water off Lambert Point to the port-warden line.

During the year ending June 30, 1891, there was expended on this improvement $4,051.16, which was applied to office expenses, surveys, and care of property.

The project of 1886 has been completed with the exception of the dike. The survey of 1889, and examinations made during the month of April, 1890, and May, 1891, indicate that the dike will not be necessary to the maintenance of the channel. No further appropriation will be required for this project at present.

July 1, 1890, balance unexpended	$4,912.73
June 30, 1891, amount expended during fiscal year	4,051.16
July 1, 1891, balance unexpended	861.57
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	108,000.00

(See Appendix K 2.)

3. *Hampton Creek and Bar, Virginia.*—An examination and survey of this river was made in 1875 in accordance with the river and harbor act of June 23, 1874.

The channel in the river was at that time 60 feet wide and 8 feet deep at mean low water. Over the bar the depth was only 6 feet.

The plan of improvement adopted was to secure a channel 150 feet wide and 9 feet deep at low water in the creek and over the bar. This improvement was secured June 30, 1880, at a cost of $12,000.

The river and harbor act of August 11, 1888, called for an examination and survey with a view to continuing the improvement.

It was recommended that the channel dredged in 1879–'80 be widened to 200 feet in the creek and from 200 to 300 feet over the bar at a total cost of $10,000.

This amount having been appropriated in the river and harbor act of 1890, a survey was made of the creek and a contract entered into for the necessary dredging.

This work will be completed during the fiscal year ending June 30, 1892.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	117.16
July 1, 1891, balance unexpended	9,882.84
July 1, 1891, amount covered by uncompleted contracts	8,500.00
July 1, 1891, balance available	1,382.84

(See Appendix K 3.)

4. *Nansemond River, Virginia.*—This river is one of the important tributaries of Hampton Roads, Virginia, and is navigable at high water

for vessels drawing 11 feet as far as the city of Suffolk, 16 miles from its mouth.

Five railroads, two of which terminate at this place, put this city in communication with the South and West, and two lines of steamers run between it and Norfolk and Baltimore.

In 1872, before any improvement was undertaken, the navigable channel of the Nansemond River was 5 feet deep at low water and was much obstructed by wrecks, snags, etc.

Between 1873 and 1878 the Government dredged a channel, wherever necessary, 8 feet deep at low water from Suffolk to Hampton Roads, at a cost of $37,000.

This depth not being sufficient to meet the demands of its growing commerce, in obedience to the requirements of the river and harbor act of August, 1886, an examination and survey of the river was made to determine what other improvement was necessary.

The plan of improvement then proposed and since adopted is to secure a channel not less than 100 feet wide at bottom, 12 feet deep at mean low water, from the head of navigation to the mouth of Western Branch, 5.37 miles, including a turning basin 200 feet square, 300 feet below Suffolk Bridge, by dredging and the construction of spurs and training walls; and a channel of like depth from mouth of Western Branch to deep water at Town Point, 200 feet wide at bottom at its upper end and gradually increasing to at least 400 feet at its lower end, etc., the total estimated cost being in round numbers $152,500.

The amount expended up to close of fiscal year ending June 30, 1890, is $8,574.51. During the fiscal year there has been expended on this work $9.82. This amount was applied to office expenses. Contract has been made for work under appropriation of September 19, 1890, which will be completed during the fiscal year ending June 30, 1892.

July 1, 1890, balance unexpended	$1,425.49
Amount appropriated by act approved September 19, 1890	10,000.00
	11,425.49
June 30, 1891, amount expended during fiscal year	9.82
July 1, 1891, balance unexpended	11,415.67
July 1, 1891, amount covered by uncompleted contracts	9,700.00
July 1, 1891, balance available	1,715.67
Amount (estimated) required for completion of existing project	132,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	32,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix K 4.)

5. *Chickahominy River, Virginia.*—In charge of Lieut. Col. Peter C. Hains, Corps of Engineers, to October 30, 1890. This river is one of the principal tributaries of the James, and is navigable at high water for vessels drawing 10 feet to Windsor Shades, and for vessels drawing 12 feet to Binn Bar, 2½ miles below Windsor Shades. The latter place, which is the head of navigation, is 25 miles from the mouth of the river.

Before improvement the channel from Windsor Shades to Binn Bar was obstructed by several shoals, over which the depth was 4 to 5 feet at low water; the entrance to the river was also obstructed by a bar.

The existing project of improvement is to dredge a channel from 100 to 150 feet wide and at least 8 feet deep at low water through the shoals near the head of navigation, and a channel 200 feet wide and 14 to 15

feet deep at low water through the bar at the mouth. The rise of the tide is about 3 feet.

Up to June 30, 1890, $21,500 had been expended on this project. The channel through the bar had been completed and that through the shoals given a least depth of 6½ feet and a least width of 40 feet.

The improved portion of the river was surveyed in January, 1891, and the dredged channels found in good condition.

A contract has been made for dredging under the appropriation of September 19, 1890; this will be completed during the fiscal year ending June 30, 1892.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	90.98
July 1, 1891, balance unexpended	2,409.02
July 1, 1891, amount covered by uncompleted contracts	2,000.00
July 1, 1891, balance available	409.02
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K 5.)

6. *Appomattox River, Virginia.*—This is one of the principal tributaries of the James River, into which it empties at City Point, Va.

It is navigable as far as the city of Petersburg, about 11 miles from its mouth.

Before improvement this river had a tortuous channel obstructed by shoals, over which there was about 6½ feet of water at high tide.

The plan of improvement adopted in 1870 was to secure a channel 12 feet deep at high tide, with as much width as the river would bear.

The amount expended by United States up to June 30, 1890, was $393,309.87, which resulted in maintaining a channel 10 to 12 feet deep in this river since 1874, and permanently securing this depth over most of the shoals.

The method of improvement consists in constructing regulating works, revetments, jetties, dikes, etc., resorting to the dredge to remove occasional shoals formed by freshets.

As this river is subject to annual freshets which bring down and deposit larger quantities of sand than the current in the navigable portion can carry off, a small annual expenditure for dredging and repair work will be necessary after the regulating works have all been completed.

During the fiscal year there was expended $4,033.07, which was devoted to repairs and dredging shoals to maintain the channel depth of 12 feet. A contract has been made and work begun on dikes, jetties, etc., to be constructed under the appropriation of September 19, 1890.

Of this work 18 jetties, aggregating in length about 2,200 feet, were nearly finished on June 30. The entire work will be completed during the fiscal year ending June 30, 1892.

July 1, 1890, balance unexpended	$453.08
Amount appropriated by act approved September 19, 1890	15,000,00
	15,453.08
June 30, 1891, amount expended during fiscal year	4,033.07
July 1, 1891, balance unexpended	11,420.01
July 1, 1891, amount covered by uncompleted contracts	4,221.45
July 1, 1891 balance available	7,198.56

Amount (estimated) required for completion of existing project.....	$15,080.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,080.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K 6.)

7. *Inland water route from Norfolk Harbor, Virginia, to Albemarle Sound, North Carolina, through Currituck Sound.*—This is one of the most important links in the chain of inland water communication along the Atlantic Coast.

It connects Chesapeake Bay with Albemarle Sound and is composed of the following bodies of water: Elizabeth River, North Landing River, Currituck Sound, Coanjok Bay, North River, and the Albemarle and Chesapeake Canal. With the exception of the canal, which was constructed and is maintained by private enterprise, all are natural waterways.

Before any improvement was undertaken by the Government there was over this route an indifferent channel 5 to 7 feet deep at low water, the navigation of which was obstructed by snags, overhanging growth, and sharp bends in all the rivers.

The project adopted was to secure a channel 80 feet wide and 9 feet deep at low water over the entire route, about 58 miles, by dredging, removing obstructions, and constructing a dike.

Steady progress has been made toward securing this result and at present the regular steamboat lines running between North Carolina ports and Norfolk and Baltimore employ vessels whose maximum dimensions are: length, 190 feet; width, 25.2 feet; draft, 8 feet, and tonnage, 421.

In the river and harbor acts before that of September 19, 1890, three separate items were inserted for this improvement; in that of September 19, 1890, one item was made to cover the entire route.

The total expenditure up to June 30, 1890, was $234,570.85.

During the fiscal year $519.04 was expended for surveys, estimates, removal of obstructions, and contingencies.

A contract has been entered into to do such dredging as is possible under the appropriation of September 19, 1890; this contract will be completed during the fiscal year ending June 30, 1892.

The revised estimate of the work still to be done on this route is based on surveys made during the fiscal year.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	519.04
July 1, 1891, balance unexpended	9,480.96
July 1, 1891, amount covered by uncompleted contracts	8,000.00
July 1, 1891, balance available	1,480.96
Amount (estimated) required for completion of existing project.....	8,677.08
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K 7.)

8. *North Landing River, Virginia and North Carolina.*—This river forms part of the "inland water route from Norfolk to Albemarle Sound" described above.

Before improvement the navigation of this river was obstructed by shoals, over which the depth was 6 feet at low water, by snags, and by sharp bends.

The plan of improvement adopted in 1879 was to secure a channel 80 feet wide and 9 feet deep at low water by dredging shoals and removing bends and obstructions.

This project was completed June 30, 1884, at a cost of $49,777.34, and the desired channel obtained for a distance of 17 miles. Since that time $3,057.35 has been expended on this river in removing sunken logs which have become detached from passing rafts.

There is still a small balance on hand for the continuation of this work and no further appropriation is necessary.

July 1, 1890, balance unexpended	$2,665.31
July 1, 1891, balance unexpended	2,665.31

(See Appendix K 8.)

9. *Currituck Sound, Coanjok Bay, and North River Bar, North Carolina.*—These waters form part of the "inland water route from Norfolk to Albemarle Sound" described above.

Previous to the commencement of this improvement there was an indifferent natural channel with a depth of from 5 to 7 feet at low water, which had been partially dredged in the sound and bay by the Albemarle and Chesapeake Canal Company.

The project of improvement adopted in 1878 was to secure by dredging a channel 80 feet wide and 9 feet deep at low water the entire length of the sound, 10½ miles.

In 1880 there was added the plan to secure a similar channel through the bay, 2 miles long, by dredging and constructing a dike.

In 1885 this was further extended by a project to secure a channel 150 feet wide and 9.4 feet deep over North River Bar.

The amount expended to June 30, 1890, was $141,656.16, and resulted in the completion of the project for the sound and the dredging of a channel through the bay and through the bar 40 feet wide and 9 feet deep.

The channels thus dredged were found in good condition when last examined in 1889–'90 and 1891.

There was expended on this improvement during the fiscal year $843.84, which was applied to examinations, surveys, care of property, and office expenses.

No further appropriation is desired for this work, as it is included under the "inland water route," and the project has been merged into the plan of improvement proposed for that route.

July 1, 1890, balance unexpended	$843.84
June 30, 1891, amount expended during fiscal year	843.84

(See Appendix K 9.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Fiebeger, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Fiebeger, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered.

1. *Chickahominy River, Virginia, from Holly Landing to Long Bridge.*—Report transmitted to Congress and printed as House Ex. Doc. No. 217, Fifty-first Congress, second session. (See also Appendix K 10.)

2. *Western Branch of Elizabeth River, Virginia.*—Report transmitted to Congress and printed as House Ex. Doc. No. 88, Fifty-first Congress, second session. (See also Appendix K 11.)

3. *Water-way to connect Lynn Haven Bay with Eastern Branch of Elizabeth River, Virginia.*—Report transmitted to Congress and printed as House Ex. Doc. No. 48, Fifty-first Congress, second session. (See also Appendix K 12.)

4. *Nottoway River, Virginia, from mouth of river to Courtland.*—Report transmitted to Congress and printed as House Ex. Doc. No. 87, Fifty-first Congress, second session. (See also Appendix K 13.)

5. *North-West River, North Carolina, up to Moyock.*—(See Appendix K 14.)

The required preliminary examination of *West Neck River, Virginia, to and beyond Dozier's Bridge*, was made by the local engineer in charge, Captain Fiebeger, and report thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Fiebeger, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement to Owen Bridge. The report of the preliminary examination, containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The improvement proposed contemplates straightening and enlarging the channel up to Owen Bridge and forming a turning basin by dredging, and removing obstructions, at an estimated cost of $9,000. (See Appendix K 15.)

IMPROVEMENT OF STAUNTON RIVER, VIRGINIA, OF ROANOKE RIVER-VIRGINIA AND NORTH CAROLINA, OF CERTAIN RIVERS AND WATER, WAYS IN NORTH CAROLINA; AND OF BEAUFORT HARBOR, NORTH CAROLINA, AND GEORGETOWN HARBOR AND WINYAW BAY, SOUTH CAROLINA.

Officers in charge, Capt. W. H. Bixby, Corps of Engineers, to August 11, 1890, and since October 15, 1890, with Lieut. Mason M. Patrick, Corps of Engineers, under his immediate orders, and Lieut. Mason M. Patrick, Corps of Engineers, in temporary charge from August 11 to October 15, 1890; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Staunton River, Virginia.*—In charge of Lieut. Col. Peter C. Hains, Corps of Engineers, to November 14, 1890. When placed under governmental improvement in 1882 and 1879, the upper portion of this stream (from Pig River to the Virginia Midland Railroad) possessed an average slope of 4.3 feet per mile and a general channel depth of over 2 feet at ordinary stages of water, except at about 30 rock shoals where it was only .4 feet; and the lower portion (from Brook Neal to Randolph) possessed an average slope of 1.2 feet per mile, and a general channel depth of 4 to 5 feet at low water except at about 18 rock ledges or shoals, where it was only about 1 to 2 feet at low water.

The original projects of 1883 for the upper portion and of 1879 for the lower portion as modified to date propose to secure a bateaux channel-way of 14 feet breadth, 1½ feet depth at low water for 23.5 miles from Pig River to the Virginia Midland Railroad, and of 35 feet

breadth, 2 feet depth at low water, and of not over 10 feet slope per mile for 31.5 miles from Brook Neal to Randolph. The total final cost of this work was estimated in 1888 at $102,700.

Up to 30th June, 1890, a total of $44,314.53, including outstanding liabilities, had been spent in all upon this improvement, securing the proposed navigation for 18½ miles above the Virginia Midland Railroad, and for 29.5 miles of the middle portion of the distance between Brook Neal and Randolph. The improvement has not yet been completed far enough to produce any special increase of commerce. Such results can not be expected to any great extent until the work is completed.

During the fiscal year ending June 30, 1891, $203.73, including outstanding liabilities, was spent on this improvement for office and minor work.

July 1, 1890, balance unexpended	$185.47
Amount appropriated by act approved September 19, 1890	8,000.00
	8,185.47
June 30, 1891, amount expended during fiscal year	203.73
July 1, 1891, balance unexpended	7,981.74
July 1, 1891, outstanding liabilities	34.74
July 1, 1891, balance available	7,947.00
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	50,200.00

(See Appendix L 1.)

2. *Roanoke River, Virginia and North Carolina.*—When placed under governmental improvement in 1872, this stream possessed a 10-foot depth of channel from its mouth, 62 miles up to Hamilton; thence a 5-foot depth, 67 miles further, to Weldon (about 8 months per year), this channel depth being reduced during the low-water season to 10 feet to Hamilton and 2 feet to Weldon. Over the whole 129 miles the river was more or less obstructed by snags, fallen trees, rocky bars, and by war obstructions.

The original projects of 1872, as so far approved, contemplated the removal of the war blockades, a few rocky bars, and all sunken logs, snags, floating and other obstructions, and the contraction of the channel-way by jetties so as to assure, during the entire year, an unobstructed 10-foot navigation up to Hamilton, and 5-foot navigation up to Weldon. The total final cost of this work below Weldon was estimated in 1872 at $269,000 for a steamboat channel of 5 feet depth at low water.

Up to June 30, 1890, a total of $102,034.82, including outstanding liabilities, had been spent upon this improvement, giving a moderately well-cleared channel over the entire length of the river, allowing a 10-foot navigation to Hamilton, and a fairly well cleared 5-foot navigation further to Weldon, all the year at ordinarily low water.

During the fiscal year ending June 30, 1891, an additional $17,005.55, including outstanding liabilities, was spent upon this improvement.

A channel 138 feet wide and 5 feet deep at dead low water was completed through Big Rocky Bar; the worst leaning trees and other obstructions have been removed from the banks, and the most dangerous rocks, snags, logs, etc., from the channel.

After the improvement is finished, its proper maintenance may cost from $2,000 to $6,000 per year.

July 1, 1890, balance unexpended	$12,536.22
Amount appropriated by act approved September 19, 1890	25,000.00
	37,536.22
June 30, 1891, amount expended during fiscal year	17,552.23
July 1, 1891, balance unexpended	19,983.99
July 1, 1891, outstanding liabilities	1,024.36
July 1, 1891, balance available	18,959.63
Amount (estimated) required for completion of existing project	131,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 2.)

3. *Pasquotank River, North Carolina.*—When placed under governmental improvement in 1890 this stream possessed a fairly cleared 9-foot navigation upward 31 miles to the lower mouth of Turner Cut, thence a poorly cleared 5-foot navigation upward 5 miles to the upper end of Turner Cut, thence a badly obstructed 3 to 4 foot navigation for flats and narrow barges upward 6 miles to Lebanon Bridge.

The original project of 1889, as continued to date, assumed that 9 feet draft could be carried from Albemarle Sound to the lower end of Turner Cut, and proposed to secure a well-cleared 5-foot navigation 5 miles further, between the ends of Turner Cut, for the use of canal boats, and to thoroughly clean out the river to its full natural width and depth for the next 6 miles for the use of flats and barges. The total final cost of such work was estimated in 1889 to be $9,000.

Up to the 30th of June, 1890, no funds had been appropriated and no work done. No results can be expected before 1892.

During the fiscal year ending 30th June, 1891, $2,340.28, including outstanding liabilities, was spent on this improvement for snagging and bank trimming, surveys, and minor work.

As a result of the year's work canal barges and one line of steamers make regular trips from Elizabeth City (near mouth of river) to Norfolk at all stages of water.

After the improvement is finished its proper maintenance may cost from $1,000 to $2,000 per year.

Amount appropriated by act approved September 19, 1890	$3,000.00
June 30, 1891, amount expended during fiscal year	2,277.70
July 1, 1891, balance unexpended	722.30
July 1, 1891, outstanding liabilities	62.58
July 1, 1891, balance available	659.72
Amount (estimated) required for completion of existing project	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 3.)

4. *Mackey Creek, North Carolina.*—When placed under governmental improvement in 1890 the lower half mile of this stream formed a fine harborage for boats of 12 feet depth and was utilized as a railroad terminus for the country between Albemarle and Pamlico Sounds. The exit from the creek across its bar was crooked and only from 5 to 7 feet deep at low water, interfering greatly with steamboat service to and from the railroad.

The original project of 1889, as continued to date, proposed to secure a straight channel of 100 feet width and 9 feet depth at low water from

the creek across the bar to Albemarle Sound. The total final cost of such work was estimated in 1889 to be $15,000.

Up to 30th June, 1890, no funds had been appropriated and no work done. No results can be expected before 1892.

During the fiscal year ending June 30, 1891, $359.48, including outstanding liabilities, was spent on this improvement for surveys and minor work and arranging for dredging to be done by contract.

The channel once thoroughly opened should remain tolerably permanent.

Amount appropriated by act approved September 19, 1890		$15,000.00
June 30, 1891, amount expended during fiscal year		349.48
July 1, 1891, balance unexpended		14,650.52
July 1, 1891, outstanding liabilities	$10.00	
July 1, 1891, amount covered by uncompleted contracts	14,000.00	
		14,010.00
July 1, 1891, balance available		640.52

(See Appendix L 4.)

5. *Ocracoke Inlet, North Carolina.*—When placed under governmental improvement in 1890, it had a good bar entrance from the ocean carrying from 12 to 15 feet depth, and two bar entrances to Pamlico Sound carrying from 4 to 6 feet depth. The commerce was limited to occasional 6 feet draft steamers, and to occasional schooners and small ships, the latter stopping just within the inlet at its small towns, Portsmouth and Ocracoke.

The original project of 1889 as continued to date proposed to improve the southern bar passage (called Portsmouth straight-way) into the Sound by dredging a channel of 300 feet width and from 10 to 15 feet depth across this bar, so as to make the passage from the inlet harborage into Pamlico Sound as good as the passage from the harborage out into the ocean. The total final cost of such work was estimated in 1889 to be $600,000.

Up to the 30th of June, 1890, no funds had been appropriated and no work was done. No results can be expected before 1892.

During the fiscal year ending June 30, 1891, $1,747.71, including outstanding liabilities, was spent on this improvement for surveys and minor work.

The channel, once thoroughly opened and diked, should remain fairly permanent.

Amount appropriated by act approved September 19, 1890	$90,000.00
June 30, 1891, amount expended during fiscal year	1,725.71
July 1, 1891, balance unexpended	88,274.29
July 1, 1891, outstanding liabilities	22.00
July 1, 1891, balance available	88,252.29
Amount (estimated) required for completion of existing project	510,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 5.)

6. *Fishing Creek, North Carolina.*—When placed under governmental improvement in 1890 this stream was badly obstructed over its entire length by very numerous snags and fallen trees in its channel and by leaning and overhanging trees on its banks, entirely obstructing any regular navigation.

The original project of 1889, as continued to date, proposed to clear out all the natural obstructions in the river up to Bellamy Mill, such as snags, fallen trees, leaning trees, overhanging trees, etc. The total final cost of this work was estimated in 1889 at $25,000.

Up to the 30th of June, 1890, no funds had been appropriated and no work done. No results can be expected before 1892.

During the fiscal year ending 30th June, 1891, no funds were spent upon this improvement, waiting until the obstructing bridges have all been withdrawn, removed, or provided with draws.

After the river is once thoroughly cleared its proper maintenance may cost from $1,000 to $2,000 per year.

Amount appropriated by act approved September 19, 1890	$10,000.00
July 1, 1891, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 6.)

7. *Pamlico and Tar rivers, North Carolina.*—The Pamlico and Tar rivers are different portions of a single stream, the upper portion being called the Tar.

When placed under improvement in 1876, the Pamlico River had an available depth of only 3 feet at low water in its upper portion, near Washington. The Tar River had, during 8 months of the year, an available depth of from 2 to 3 feet for 48 miles up to Tarboro, its practical limit of navigation. The channel of the combined stream was almost completely obstructed by two war blockades, and by floating and sunken stumps and logs, and by overhanging trees.

The original project of 1876 (for the Pamlico) and of 1879 (for the Tar), as since slightly modified and continued to date, proposed to secure a clear channel 9 feet deep at low water up to Washington; thence a channel 60 feet wide and 3 feet deep at low water, 22 miles farther, to Greenville; and thence a channel 60 feet wide and 20 inches deep, 58 miles farther, to Tarboro and Rocky Mount Little Falls. The final total cost of this work was estimated in 1889 at $92,200.

Up to June 30, 1890, a total of $66,227.90, including outstanding liabilities, had been spent upon this improvement in securing a good channel at least 9 feet deep at low water, and at least 108 feet wide from Pamlico Sound up to Washington; thence a fair channel 60 feet wide and 3 feet deep all the year, to Greenville; and thence a similar channel for 8 months of the year, to Tarboro.

During the fiscal year ending June 30, 1891, an additional $2,565.23, including outstanding liabilities, was spent on this improvement in minor field work, and in surveys to be used in locating future work.

After the improvement is finished its proper maintenance may cost from $1,000 to $3,000 per year.

July 1, 1890, balance unexpended	$1,873.55
Amount appropriated by act approved September 19, 1890	10,000.00
	11,873.55
June 30, 1891, amount expended during fiscal year	2,617.34
July 1, 1891, balance unexpended	9,256.21
July 1, 1891, outstanding liabilities	49.34
July 1, 1891, balance available	9,206.87

Amount (estimated) required for completion of existing project	$14,200.00
Amount (estimated) required for completion of new project	45,000.00
	59,200.00
Amount that can be profitably expended in fiscal year ending June 30,1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 7.)

8. *Contentnia Creek, North Carolina.*—When placed under improvement in 1881 this stream had a depth of about 3 feet during 9 months of the year, from its mouth in the Neuse upwards about 63 miles to Stantonsburg, its practical limit of navigation; but its channel was completely blocked at all stages of water by sunken logs and stumps, and by floating obstructions.

The original project of 1881, as continued to date, proposed to secure a safe and unobstructed 3-foot navigation over this distance during the high-water season of about 9 months. The final total cost of this work was estimated in 1888 at $77,500.

Up to June 30, 1890, a total of $43,928.52, including outstanding liabilities, had been spent in securing a moderately well-cleared 3-foot navigation over the 31 miles from its mouth up to Snow Hill, and a roughly cleared 3-foot navigation over 32 miles farther to Stantonsburg, during the high-water season.

During the fiscal year ending June 30, 1891, an additional $4,772.98, including outstanding liabilities, was spent upon this improvement for minor field work, surveys, and office work.

After the improvement is finished its proper maintenance may cost from $1,000 to $3,000 per year.

July 1, 1890, balance unexpended	$1,124.98
Amount appropriated by act approved September 19, 1890	7,000.00
	8,124.98
June 30, 1891, amount expended during fiscal year	4,536.08
July 1, 1891, balance unexpended	3,588.90
July 1, 1891, outstanding liabilities	290.40
July 1, 1891, balance available	3,298.50

Amount (estimated) required for completion of existing project	25,500.00
Amount that can be profitably expended in fiscal year ending June 30,1893	25,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 8.)

9. *Trent River, North Carolina.*—When placed under improvement in 1879 this river had a 6-foot to 8-foot roughly cleared navigation from its mouth at New Berne, up 18 miles to Pollocksville, and a light-draft navigation 7 miles farther to Quaker Bridge. Above Pollocksville the bars, snags, and trees prevented all navigation, except occasionally by small flatboats during high freshets.

The original projects of 1879 to 1889, as continued to date, assumed that 6 to 8 feet of water could be carried at all stages from its mouth 18 miles to Pollocksville, and proposed to secure a thoroughly cleared 3-foot navigation, with at least 50 feet channel width at all stages of water from Pollocksville, 20 miles up, to Trenton, and at least 30 feet channel width and over 3 feet depth during winter stages of water from Trenton, 30 miles up, to the Narrows above Free Bridge, and a good channel for pole-boats 13 miles farther to Upper Quaker Bridge. The total final cost of this work was estimated in 1889 at $72,000.

Up to June 30, 1890, a total of $50,379.41, including outstanding liabilities, had been spent in all upon this improvement in securing a well-cleared channel 10 to 12 feet deep at all stages (12 to 14 feet at ordinary stages) from New Berne to Pollocksville; thence a well-cleared channel 6 to 8 feet deep at all stages (8 to 9 feet deep at ordinary stages) to Quaker Bridge; thence a well-cleared channel 50 feet wide and 3 feet deep at all stages to Trenton, and a good turning basin at Trenton. In consequence of this improvement steamboat navigation has been permanently established over the entire river to Trenton.

During the fiscal year ending June 30, 1891, an additional $3,517.66, including outstanding liabilities, was spent on this improvement for minor field work, surveys, and office work, extending the improvement 7 miles above Trenton.

After the improvement is finished its proper maintenance may cost from $1,000 to $2,000 per year.

July 1, 1890, balance unexpended	$175.12
Amount appropriated by act approved September 19, 1890	5,000.00
	5,175.12
June 30, 1891, amount expended during fiscal year	3,534.56
July 1, 1891, balance unexpended	1,640.56
July 1, 1891, outstanding liabilities	37 63
July 1, 1891, balance available	1,602.93
Amount (estimated) required for completion of existing project	16,500 00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 9.)

10. *Neuse River, North Carolina.*—When placed under improvement in 1878, this river had during 9 months of the year a 9-foot depth of channel from its mouth 40 miles up to New Berne, thence a 4-foot depth 50 miles farther to Kinston, thence a 3-foot depth 45 miles farther to Goldsboro, and thence a 2-foot depth 55 miles farther to Smithfield, this channel depth being reduced during the low-water season to 8 feet at New Berne, 2 feet at Kinston, and 1 foot at Smithfield. Over the whole 190 miles the river was so blocked by war and other obstructions that navigation was impracticable.

The original projects of 1871 for below Goldsboro, and of 1879 for above Goldsboro, contemplated the removal of the war blockades and natural obstructions and the excavation of a few cut-offs, so as to get 4.5 feet at low water all the year to Goldsboro, and 3 feet during 9 months to Smithfield. The projects of 1878, 1880, and 1883, as continued to date, propose to remove all sunken logs, snags, floating and other obstructions, and to contract the channel-way by jetties, so as to assure during the entire year an unobstructed 8-foot navigation 40 miles up to New Berne, and a similar 4-foot navigation 50 miles farther to Kinston, and during 9 months of the year a 3-foot navigation 100 miles farther to Smithfield. The final total cost of this work was estimated in 1888 at $374,000.

Up to June 30, 1890, a total of $245,498.43, including outstanding liabilities, had been spent in all upon this improvement, giving a moderately well-cleared channel over the entire length of the river, allowing an 8-foot navigation to New Berne and a 3-foot navigation to Kinston all the year; also a fair 3-foot navigation to Goldsboro during 9 months per year, and to Smithfield occasionally.

During the fiscal year ending June 30, 1891, an additional $8,578.33, including outstanding liabilities, was spent in contracting by jetties a portion of the river below Kinston; in removing the worst obstructions from the banks and from the channel over the 95 miles of the river below the railroad bridge at Goldsboro.

After the improvement is finished its proper maintenance may cost from $2,000 to $6,000 per year.

July 1, 1890, balance unexpended		$4,076.81
Proceeds of sale		175.90
Amount appropriated by act approved September 19, 1890		20,000.00
		24,252.71
June 30, 1891, amount expended during fiscal year		9,378.26
July 1, 1891; balance unexpended		14,874.45
July 1, 1891, outstanding liabilities		1,275.31
July 1, 1891, balance available		13,599.14
Amount (estimated) required for completion of existing project		106,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		60,000.00
Submitted in compliance with requirements of sections 2 of river and harbors acts of 1866 and 1867.		

(See Appendix L 10.)

11. *Inland water-way between New Berne and Beaufort, North Carolina.*—The inland line of navigation from New Berne to Beaufort Harbor, via Clubfoot, Harlowe, and Newport rivers, was established by the State of North Carolina about 1826, and was used thereafter by small craft until about 1856, when its locks broke down and the route was abandoned. This line, about 39 miles in total length, extends from New Berne about 21 miles down the Neuse River, 5 miles up Clubfoot River, 3 miles through the Clubfoot and Harlowe Canal, 4 miles down Harlowe River, and 6 miles through Newport River to Beaufort Harbor. About 1880 the line was reopened by the New Berne and Beaufort Canal Company.

When placed under improvement in 1885 this route allowed the passage of small boats of 15 feet width and 3 feet draft, but the commerce was practically nothing.

The original project of 1883 reported this route as worthy of improvement, providing that Congress desired to extend the already existing lines of navigation from the Chesapeake southward, and estimated the cost of a channel 80 feet wide and 9 feet deep at $883,580, increased by the cost of a tide-lock and the canal company's franchise.

A modified project of 1884 for the expenditure of the funds then available; as continued to date, proposed to widen and deepen Harlowe Creek so as to secure a through channel of 5 feet depth at mean low water and of 30 feet bottom width from the mouth of Harlowe Creek upwards 4 miles to its head, and to use the remaining funds upon similar works upon Clubfoot River. The total final cost of this latter project (including also the continuation of the same work through the canal) was estimated in 1886 at $92,000.

Up to June 30, 1890, a total of $26,603.12, including outstanding liabilities, had been spent in all upon this improvement, on necessary surveys, in removing the worst logs and stumps from the existing channel, in dredging an excellent channel 13,000 feet long, 30 feet wide, and 5 feet deep at low water through the worst portions of Harlowe Creek, thus securing a far better navigation through this creek than exists through the New Berne and Beaufort Canal, to which it leads.

During the fiscal year ending June 30, 1891, an additional $476.28, including outstanding liabilities, was spent in repairs of sheet piling, in office duties and minor work.

Further work is postponed to await action on the part of the owners of the canal as to its cession or sale.

After the proposed channel is opened its proper maintenance may cost from $1,000 to $3,000 per year.

July 1, 1890, balance unexpended	$8,401.88
June 30, 1891, amount expended during fiscal year	481.28
July 1, 1891, balance unexpended	7,920.60
Amount (estimated) required for completion of existing project	57,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	57,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 11.)

12. *Harbor at Beaufort, North Carolina.*—This harbor, at the eastern terminus of the Atlantic and North Carolina Railroad, is the only harbor of any importance between Chesapeake Bay and Wilmington, N. C., a distance of over 300 miles.

When placed under improvement, in 1880, it possessed a bar entrance of 15.3 feet least depth at mean low water, with an average rise and fall of tide of 3 feet. At this time, however, the harbor entrance was rapidly deteriorating, its width, measured from Fort Macon Point to Shackleford Point, having increased 500 feet between the years 1864 and 1880, and 900 feet more between the years 1880 and 1881, and its bar having rapidly and proportionally shoaled. From the bar the harbor possessed a channel of 25 feet depth upwards for 3.7 miles to the Atlantic and North Carolina Railroad Wharf at Morehead City, and a branch channel of 9 feet depth for six-tenths of a mile up to Bulkhead Channel, and of 2 feet minimum depth for six-tenths of a mile farther to the wharves of Beaufort City, where coasting vessels had a good wharfage of 7 feet depth and 1,800 feet length.

The projects of 1881, 1882, and 1884, as continued to date, proposed to secure this harbor by stopping further erosion of the sand-banks at Shackleford Point and Fort Macon Point, and thus stopping further deterioration of the bar entrance, and proposed to open a 7-foot channel 100 feet wide to Beaufort City. The total final cost of this work was estimated in 1887 at $163,000.

Up to June 30, 1890, a total of $122,034.43, including outstanding liabilities, had been spent in all upon this improvement in successfully stopping the erosion of Shackleford Point and Fort Macon Point, in arresting the shoaling on this bar, in building catch-sand-fences at Shackleford Point, in cutting a narrow channel through the shoal in front of Beaufort City, and in making a careful survey of the present condition of the harbor entrance preparatory to the definite location of future work.

During the fiscal year ending June 30, 1891, an additional $1,638.91, including outstanding liabilities, was spent in building and raising catch-sand-fences and shore revetments at Shackleford Point and Fort Macon Point, and in office and minor field work.

This improvement, once thoroughly finished, should be comparatively permanent.

July 1, 1890, balance unexpended		$3,140.04
Amount appropriated by act approved September 19, 1890		15,000.00
		18,140.04
June 30, 1891, amount expended during fiscal year		1,680.53
July 1, 1891, balance unexpended		16,459.51
July 1, 1891, outstanding liabilities	$132.85	
July 1, 1891, amount covered by uncompleted contracts	12,000.00	
		12,132.85
July 1, 1891, balance available		4,326.66
Amount (estimated) required for completion of existing project		23,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		23,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L 12.)

13. *Inland water-way between Beaufort Harbor and New River, North Carolina.*—When placed under improvement, in 1886, there was a channel 18 inches deep at low water from Beaufort to the town of Swansboro, on White Oak River; thence a 3-foot depth at mid-tide, 6 miles farther to Bear Inlet and Creek; thence a 6-inch depth at low water 11 miles farther to New River, whence boats of 5 feet draft could proceed 21 miles farther to the town of Jacksonville.

The original project of 1885, as continued to date, recommended the establishment of a channel of at least 3 feet depth at low water from Beaufort to Swansboro. The total final cost of this work was estimated in 1887 at $50,000.

Up to June 30, 1890, a total of $14,637.89, including outstanding liabilities, had been spent in all upon this improvement in securing a channel-way of at least 40 feet width and of 3 feet depth at high water from Beaufort to Swansboro.

During the fiscal year ending June 30, 1891, an additional $4,866.92, including outstanding liabilities, was spent in office duties and minor work, no field work being advantageously possible with the small amount of funds available.

Government property was stored and cared for at Beaufort, N. C.

This improvement, once thoroughly finished, should be comparatively permanent.

July 1, 1890, balance unexpended		$362.11
Amount appropriated by act approved September 19, 1890		15,000.00
		15,362.11
June 30, 1891, amount expended during fiscal year		4,394.72
July 1, 1891, balance unexpended		10,967.39
July 1, 1891, outstanding liabilities	$472.20	
July 1, 1891, amount covered by uncompleted contracts	5,306.82	
		5,779.02
July 1, 1891, balance available		5,188.37
Amount (estimated) required for completion of existing project		20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L 13.)

14. *Water-way between New River and Swansboro, North Carolina.*—When placed under Governmental improvement in 1890 this water-way possessed a 0.5-foot depth at low water from New River 10 miles to Browns Inlet, thence a 0.5-foot depth 5 miles farther to Bear's Inlet,

and thence a 1.2-foot depth 7 miles farther to Bogue Inlet, White Oak River and Swansboro.

The original project of 1889, as continued to date, proposed to open this route to at least 40 feet width and from 3 to 4 feet depth at high water, from New River to Swansboro, by dredging. The total final cost of this work was estimated in 1889 at $43,000.

Up to 30th of June, 1890, no funds had been appropriated and no work done. No results can be expected before 1892.

During the fiscal year ending June 30, 1891, $509.76, including outstanding liabilities, was spent upon this improvement for surveys and minor work.

The channel once thoroughly cleared should remain fairly permanent.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	484.00
July 1, 1891, balance unexpended	4,516.00
July 1, 1891, outstanding liabilities	25.76
July 1, 1891, balance available	4,490.24
Amount (estimated) required for completion of existing project	38,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 14.)

15. *New River, North Carolina.*—When placed under improvement in 1882 this river had very poor facilities for transporting goods to market. Its outlet to the ocean was blocked by an oyster-rock barricade, through which there existed only a long and very crooked channel of 50 feet width and 3 feet depth at low water.

The original project, as continued to date, proposed to secure a 150-foot channel 5 feet deep at low water, from the upper river to the ocean, by dredging. The total final cost of this work was estimated in 1885 at $40,000.

Up to June 30, 1890, a total of $19,188.18, including outstanding liabilities, had been spent in all upon this improvement in replacing the long and crooked channel by a shorter and straighter channel of at least 40 feet bottom width and 3.5 feet depth at low water.

This new channel has been used by the craft entering New River from the ocean, but is only of partial value because of its present incompleteness.

During the fiscal year ending June 30, 1891, an additional $499.85, including outstanding liabilities, was spent upon this improvement in office work, in surveys, in minor field work, and the construction of an oyster-shell dike just below the south mouth of Cedar Brush Marsh Cut.

This improvement, once thoroughly completed, should be comparatively permanent.

July 1, 1890, balance unexpended		$4,253.69
Amount appropriated by act approved September 19, 1890		5,000.00
		9,253.69
June 30, 1891, amount expended during fiscal year		910.65
July 1, 1891, balance unexpended		8,343.04
July 1, 1891, outstanding liabilities	$31.07	
July 1, 1891, amount covered by uncompleted contracts	6,500.00	
		6,531.07
July 1, 1891, balance available		1,811.97

Amount (estimated) required for completion of existing project.....	$12,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 15.)

16. *North East (Cape Fear) River, North Carolina.*—When placed under governmental improvement in 1890 this stream possessed a depth of from 6 to 30 feet at low water from Wilmington upward 50 miles to near Bannerman's Bridge, easily navigable by small steamers carrying two flats abreast. Thence 40 miles farther to near Hallsville it had a depth of about 3 feet at ordinary stages of water. Thence 13 miles farther up to Kornegay's Bridge it had a depth and width suited only to pole-boats and rafts. Everywhere above Bannerman's Bridge it was badly obstructed by snags, and by overhanging, leaning, and fallen trees, so as to completely block navigation at all ordinary stages of water.

The original projects of 1889 as continued to date proposed the removal of all obstructions, such as snags, and overhanging, leaning, and fallen trees, stumps, etc., so as to thoroughly clear a channel of good width and natural depth for small light-draft steamboats up to Hallsville and for pole-boats up to Kornegay's Bridge. The total final cost of this work was estimated in 1889 at $30,000.

Up to 30th of June, 1890, no appropriations had been made for this work. Consequently no work had been done and no benefits received. No results can be expected before 1892.

During the fiscal year ending 30th June, 1891, $160, including outstanding liabilities, was spent upon this improvement for snagging and bank trimming, surveys, and minor work.

The work of the past year has already much benefited navigation, allowing light-draft steamers to go 56 miles up the river (to Kroom's Bridge) all the year, thence 18 miles farther (to Deep Bottom Bridge) during about 9 months of the year, and thence 5 miles farther (to Chinquapin) during from 6 to 8 months of the year; all these places being important shipping points during the busy seasons.

After this improvement is finished its proper maintenance may cost from $1,000 to $2,000 per year.

Amount appropriated by act approved September 19, 1890.....	$5,000.00
June 30, 1891, amount expended during fiscal year.....	3,133.60
July 1, 1891, balance unexpended	1,866.40
July 1, 1891, outstanding liabilities.....	40.00
July 1, 1891, balance available.....	1,826.40

Amount (estimated) required for completion of existing project.....	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 16.)

17. *Black River, North Carolina.*—When placed under improvement in 1886 this river had a moderately well-cleared channel from its mouth (in the Cape Fear River, 15 miles above Wilmington) 22 miles upwards to Point Caswell, with 2.5 feet depth at low water and 4 feet depth at high tide; thence a roughly cleared navigation 48 miles farther to near Lisbon, with 2.5 feet depth during 9 months per year, and with 6 feet depth during 6 months per year.

The original project of 1885, as continued to date, proposed to secure a fairly cleared natural channel over the entire river from its mouth up 70 miles to near Lisbon, then a 4-foot channel below Point Caswell, and then an improved channel through the narrows. The total final cost of this work was estimated in 1885 at $33,500.

Up to June 30, 1890, a total of $2,896.85, including outstanding liabilities, had been spent upon this improvement in the removal of the worst obstructions over the entire river.

During the fiscal year ending June 30, 1891, an additional $140, including outstanding liabilities, was spent in office duties and in minor field work.

After this improvement is finished its proper maintenance may cost from $1,000 to $3,000 per year.

July 1, 1890, balance unexpended	121.48
Proceeds of sale	39.45
	160.93
June 30, 1891, amount expended during fiscal year	155.00
July 1, 1891, balance unexpended	5.93
July 1, 1891, outstanding liabilities	3.33
July 1, 1891, balance available	2.60
Amount (estimated) required for completion of existing project	30,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 17.)

18. *Cape Fear River, North Carolina, above Wilmington.*—When placed under improvement in 1881 the Cape Fear River above Wilmington was navigable during 9 months of the year from Wilmington 115 miles upwards to Fayetteville, but the channel for the upper 75 miles was badly obstructed by logs, snags, overhanging trees, and shoals, and for the upper 66 miles it was full of shoals, on which there was not more than 12 to 14 inches of water during the low-water season. At that time the navigation was owned by private parties.

The original project of 1881–'82, as continued to date, proposed to buy out the private owners of the river for $10,000, then to clear out its natural obstructions, and to further provide a continuous channel over its upper 66 miles by dredging and by artificially contracting its water-ways through at least thirty-two shoals. The total cost of this work was estimated in 1885 at $480,000 for a 3-foot actual channel depth up to Fayetteville during 11 or 12 months of the year.

Up to June 30, 1890, a total of $87,971.26, including outstanding liabilities, had been spent in all upon this improvement, giving a moderately good 4-foot continuous channel during the entire year from Wilmington 46 miles to Kelly Cove; thence a similar 3-foot channel 27 miles farther, to Elizabethtown; and thence a 2-foot channel 42 miles farther, to Fayetteville, increased to 5-foot depth from Wilmington to Fayetteville during 9 months of the year.

During the fiscal year ending June 30, 1891, an additional $6,379.17, including outstanding liabilities, was spent in maintaining the existing channel, in quarrying rock, and in building the same into jetties at various shoals in the river.

Work was stopped in October on account of winter high water, and the near exhaustion of funds.

After this improvement is completed its proper maintenance may cost from $1,000 to $3,000 per year.

July 1, 1890, balance unexpended	$359.20
Amount appropriated by act approved September 19, 1890	15,000.00
	15,359.20
June 30, 1891, amount expended during fiscal year	5,288.28
July 1, 1891, balance unexpended	10,070.92
July 1, 1891, outstanding liabilities	1,171.35
July 1, 1891, balance available	8,899.57
Amount (estimated) required for completion of existing project	173,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 18.)

19. *Cape Fear River, North Carolina, at and below Wilmington.*—When placed under improvement, in 1829, the Cape Fear River below Wilmington had three bar entrances, with least depth as follows: About 9 feet at the Baldhead Channel, 9 feet at the Rip Channel, and 10 feet at New Inlet Channel, these bars being, respectively, 9, 6, and 2 miles below the point which was then the head of the river's delta. From the head of this delta, 20 miles up to Wilmington, there were several shoals with a least depth of 7.5 feet at low water.

The original projects of 1827 to 1885 proposed to improve the upper 20 miles by dredging and by jetty contraction of the channel; to close the New Inlet Channel; to dike the river from New Inlet 3 miles downstream; and to improve the bar by the consequent increased scour of the river as well as by occasional dredging,—all to secure a 16-foot channel from Wilmington to the ocean.

The total final cost of this work under the projects of 1827 to 1885 was in 1889 estimated to be $2,489,500.85.

New projects of 1889 extended the work of the proposed improvement to obtain a depth of 20 feet at low water from Wilmington to the ocean at a total increased cost of $1,800,000.

Up to June 30, 1890, a total of $2,453,386.72, including outstanding liabilities, had been spent in all upon the proposed improvements of 1827 to 1885 with great success, obtaining 16 feet least depth of water at the main bar entrance, and completing a channel of 16 feet depth and at least 233 feet width 28 miles farther, to Wilmington. This depth, combined with the average rise of tide—4.5 feet at the bar, and 2.5 at Wilmington—is such that at that time vessels loaded to 18 feet draft (10.5 feet more than in 1827) could readily go from Wilmington to the ocean in a single tide any day of the year.

During the fiscal year ending June 30, 1891, an additional $65,708.74, including outstanding liabilities, was spent in maintaining and deepening the new channel across the ocean bar, in widening the channels across the shoals in the upper river to the full width of 270 feet, and deepening some of them to 20 feet depth at low water.

Vessels of 18 feet draft now reach Wilmington.

Recent surveys show successful results everywhere, and 16 feet low-water depth across the bar as well as in the river channels.

After the improvement is finished, its proper maintenance may cost from $5,000 to $25,000 per year for a few years, but the improvement should be fairly permanent.

July 1, 1890, balance unexpended		$13,476.04
Proceeds of sale		60.00
Amount appropriated by act approved September 19, 1890		170,000.00
		183,536.04
June 30, 1891, amount expended during fiscal year		55,423.42
July 1, 1891, balance unexpended		128,112.62
July 1, 1891, outstanding liabilities	$12,647.23	
July 1, 1891, amount covered by uncompleted contracts	85,953.59	
		98,600.82
July 1, 1891, balance available		29,511.80
Amount (estimated) required for completion of existing project		1,655,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 19.)

20. *Lockwood's Folly River, North Carolina.*—When placed under governmental improvement, in 1890, it possessed a depth of about 3 feet at low water (8 feet at high water) upon its ocean bar; thence about 8 feet depth at low water for about 1.5 miles; thence only about 1 foot depth at low water for about 400 feet; thence from 3 to 6 feet at low water for 1.5 miles; and thence from 5 to 8 feet at low water for 22 miles up to Lockwood's Folly Bridge. Above the bridge the river is only suitable to pole-boats, which might carry merchandise 15 miles farther.

The original project of 1887, as continued to date, proposed to dredge through the oyster rocks and mud flats so as to secure a 6-foot navigation at low water, from the ocean upward 25 miles to Lockwood's Folly town bridge. The total final cost of this work was estimated in 1887 at $40,000.

Up to June 30, 1890, no appropriations had been made for this work, consequently no work had been done and no benefits received. No results can be expected before 1892.

During the fiscal year ending June 30, 1891, $19.81, including outstanding liabilities, was spent upon this improvement for office and minor work, and arranging for the dredging to be done by contract.

This improvement, once thoroughly completed, should remain fairly permanent.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	19.81
July 1, 1891, balance unexpended	4,980.19
July 1, 1891, amount covered by uncompleted contracts	3,500.00
July 1, 1891, balance available	1,480.19
Amount (estimated) required for completion of existing project	35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L 20.)

21. *Yadkin River, North Carolina.*—The middle third of this river, the portion extending from the railroad bridge near Salisbury, 64½ miles upward, to the foot of Bean Shoal, is the only portion so far under improvement by the General Government.

When placed under improvement, in 1880, this portion of the Yadkin River had its navigation completely obstructed by rock ledges, fish, and mill-dams, and numerous shoals, with a greatest depth of 1 foot at ordinary low water on some of its shoals and ledges.

The original project of 1879 proposed to secure a 2.5 to 3 foot steamboat navigation during the entire year over the 64½ miles above the Salisbury Railroad Bridge.

Modified project of 1887 proposed to limit this improvement to obtaining this depth only during winter stages of water and only over the lower 33 miles of river, at a total cost of $107,000.

Up to June 30, 1890, a total of $96,450.48, including outstanding liabilities, had been spent in all upon this improvement in securing a channel of 40 to 70 feet channel width, and from 2 to 2½ feet channel depth during mean winter stages of water (8 months of the year) from the Salisbury Railroad Bridge 33 miles upward to Bailey Ferry.

During the fiscal year ending June 30, 1891, an additional $2,721.06, including outstanding liabilities, was spent in removing rock and sand from the channel, in building rock jetties, and in minor work. All work in the field was suspended during winter, on account of cold weather, high water, and the small amount of funds.

The improvement, once thoroughly completed, should be comparatively permanent.

July 1, 1890, balance unexpended	$722.52
Proceeds of sale	200.00
Amount appropriated by act approved September 19, 1890	5,000.00
	5,922.52
June 30, 1891, amount expended during fiscal year	2,462.32
July 1, 1891, balance unexpended	3,460.20
July 1, 1891, outstanding liabilities	431.74
July 1, 1891, balance available	3,028.46
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 21.)

22. *Harbor at Georgetown, South Carolina.*—When placed under improvement, in 1880, this harbor had an excellent and well-protected anchorage of at least 1 mile in length, 150 feet width, and 15 feet depth. A bar of about 2,850 feet in length and with only 9 feet depth of water was the only obstacle to an otherwise good 13-foot navigation from Georgetown 13 miles to the ocean.

The original project of 1881, as continued to date, proposed to secure a dredged channel of 200 feet bottom width and 12 feet low-water depth entirely through the bar. The total final cost of this work was estimated in 1889 at $44,500.

Up to June 30, 1890, a total of $23,877.57, including outstanding liabilities, had been spent, in all, upon this improvement, giving a through cut entirely across the bar, with 12 feet low-water depth, and with a variable width of from 80 to 100 feet.

During the fiscal year ending June 30, 1891, an additional $58.16, including outstanding liabilities, was spent on this improvement in office and minor work.

The channel once thoroughly opened will probably be permanent.

July 1, 1890, balance unexpended	$622.43
Amount appropriated by act approved September 19, 1890	8,000.00
	8,622.43
June 30, 1891, amount expended during fiscal year	58.16
July 1, 1891, balance unexpended	8,564.27
July 1, 1891, amount covered by uncompleted contracts	7,000.00
July 1, 1891, balance available	1,564.27
Amount (estimated) required for completion of existing project	12,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L 22.)

23. *Winyaw Bay, South Carolina.*—When placed under improvement in 1886 this bay had only 9 feet least depth upon its bar entrance, with a 12-foot channel the rest of the way to Georgetown.

The original project of 1885 proposed to secure a permanent bar entrance from 15 to 20 feet depth of water.

The total final cost of this work was estimated in 1885 at $2,500,000 for a bar depth of from 15 to 20 feet (the first $800,000 to secure a depth of about 12 feet) at low water.

Up to June 30, 1890, a total of $20,027.45, including outstanding liabilities, had been spent upon this improvement in making necessary preparations for beginning work, and in building the shore end of the jetty.

During the fiscal year ending June 30, 1891, an additional $12,809.43, including outstanding liabilities, was spent on this work in building the shore end of the proposed jetty.

The channel, once thoroughly opened, will probably retain its depth permanently.

July 1, 1890, balance unexpended		$100,320.57
Amount appropriated by act approved September 19, 1890		100,000.00
		200,320.57
June 30, 1891, amount expended during fiscal year		8,561.76
July 1, 1891, balance unexpended		191,758.81
July 1, 1891, outstanding liabilities	$5,845.69	
July 1, 1891, amount covered by uncompleted contracts	172,041.79	
		177,887.48
July 1, 1891, balance available		13,871.33
Amount (estimated) required for completion of existing project		2,281,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L 23.)

24. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wreck of an old schooner opposite Swan Point, Pamlico River, North Carolina, was reported in March, 1891, as obstructing and endangering navigation. Authority was given for its removal by hired labor, by the Government snagging plant on its next passage over the river, at an expense not exceeding $150. No work was actually done, however, prior to 30th June, 1891.

(See Appendix L 24.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Bixby, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Bixby, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys of these localities were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Water-way from Pungo River to the town of Sladesville, North Carolina.*—Printed as House Ex. Doc. No. 160. (See also Appendix L 25.)

2. *Water-way between Pamlico River and Bay River, North Carolina.*—Printed as House Ex. Doc. No. 162. (See also Appendix L 26.)

3. *Drum Inlet, North Carolina.*—Printed as House Ex. Doc. No. 164. (See also Appendix L 27.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Bixby, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Bixby, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The reports of the preliminary examinations containing sufficient information to indicate to Congress the probable cost of the work required, no further surveys appear to be necessary at this time. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Harbor of Washington, Pamlico River, North Carolina.*—The proposed improvement contemplates dredging a channel 200 feet wide and 9 feet deep at ordinary low water, at an estimated cost of $45,000. Printed as House Ex. Doc. No. 289. (See also Appendix L 28.)

2. *White Oak River, North Carolina, from Roberts' Landing to Collins Crossing.*—The work proposed consists in providing for steamboat navigation from Robert's Landing to Sabiston's Bridge, 4 miles, and for flat-boat navigation from Sabiston's Bridge to Collins Crossing, 21 miles, at an estimated cost of $4,550. Printed as House Ex. Doc. No. 97. (See also Appendix L 29.)

3. *Black River, South Carolina, from Kingstree to its mouth.*—The proposed improvement contemplates the removal of such obstructions as snags and fallen and overhanging trees, from its mouth upward 118 miles to the railroad bridge at Kingstree, at an estimated cost of $25,000. Printed as House Ex. Doc. No. 286. (See also Appendix L 30.)

IMPROVEMENT OF LUMBER AND WACCAMAW RIVERS, NORTH CAROLINA AND SOUTH CAROLINA, AND OF CERTAIN RIVERS AND HARBORS IN SOUTH CAROLINA.

Officer in charge, Capt. Frederic V. Abbot, Corps of Engineers, with Lieut. E. J. Spencer, Corps of Engineers, under his immediate orders to August 12, 1890; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Waccamaw River to Waccamaw Lake, North Carolina and South Carolina.*—In 1880 this river was navigable for 12-foot draft boats at all stages of water from Georgetown, 23 miles to Bull Creek, and at high

water 4 miles farther to Buck's lower mills; thence for 7-foot draft boats at high water, 22 miles farther to Conway; thence it possessed an obstructed channel for 3-foot draft boats at ordinary winter water, 70 miles to Reeves Ferry, the present head of steam navigation; thence an obstructed channel with 3 feet depth at high water, 30 miles to Lake Waccamaw. The commerce of this river is estimated to have been about $400,000 per year. The project provides for a channel 12 feet deep at all stages of water, and 80 feet bottom width from the mouth of the river to Conway; thence a cleared channel to Lake Waccamaw.

During the fiscal year ending June 30, 1891, a large amount of snagging has been done. Much good has resulted. Up to June 30, 1891, $73,700.46 has been spent on this river, giving a thoroughly cleared channel with 100 feet least width, 7 feet deep at low water as far as Conway, and 40 feet width and 3 feet depth 72 miles above Conway.

July 1, 1890, balance unexpended	$224.87
Amount appropriated by act approved September 19, 1890	12,500.00
	12,724.87
June 30, 1891, amount expended during fiscal year	8,525.33
July 1, 1891, balance unexpended	4,199.54
July 1, 1891, outstanding liabilities	1,120.60
July 1, 1891, balance available	3,078.94
Amount (estimated) required for completion of existing project	60,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 1.)

2. *Lumber River, North Carolina and South Carolina.*—The river is obstructed by logs, snags, stumps, overhanging trees, and in places by sand bars. It is crossed by a number of bridges without draws. Its present commerce is small.

The project contemplates the removal of snags, logs, overhanging trees, etc., on 70 miles below Lumberton, at an estimated cost of $35,000. During the year a large amount of snagging has been done on the river, and several of the bridges have been provided with draw spans or have been discontinued. The amount expended up to the close of the fiscal year ending June 30, 1891, is $5,643.06.

July 1, 1890, balance unexpended	$2,884.23
Amount appropriated by act approved September 19, 1890	5,000.00
	7,884.23
June 30, 1891, amount expended during fiscal year	3,527.29
July 1, 1891, balance unexpended	4,356.94
July 1, 1891, outstanding liabilities	300.10
July 1, 1891, balance available	4,056.84
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 2.)

3. *Little Pedee River, South Carolina.*—This river was much obstructed by snags and overhanging trees, and in places was subdivided

into several branches. The project provides for removing obstructions and closing unnecessary branches. Steamboat navigation is provided for to Lumber River and pole-boat navigation to Little Rock. The estimated cost is $50,000. The work of the year has been snagging. The commerce amounts to about $52,000.

The total expenditures to June 30, 1891, were $7,138.41.

July 1, 1890, balance unexpended	$417.22
Amount appropriated by act approved September 19, 1890	5,000.00
	5,417.22
June 30, 1891, amount expended during fiscal year	2,555.63
July 1, 1891, balance unexpended	2,861.59
July 1, 1891, outstanding liabilities	279.32
July 1, 1891, balance available	2,582.27
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 3.)

4. *Great Pedee River, South Carolina.*—This river was dangerously obstructed by snags and logs. The project provides for thoroughly cleared 9-foot navigation to Smith's Mills, and a 3½-foot navigation to Cheraw, 172 miles above the mouth, at all stages of water. At ordinary stages there is a well-cleared 9-foot channel to Smith's Mills, and a thoroughly cleared 3½-foot channel at low water 50 miles farther, or at high water to Cheraw. During the fiscal year ending June 30, 1891, a large amount of snagging has been done. Substantial improvement has resulted.

The total expenditures up to June 30, 1891, were $70,039.02.

July 1, 1890, balance unexpended	$3,158.21
Amount appropriated by act approved September 19, 1890	12,500.00
	15,658.21
June 30, 1891, amount expended during fiscal year	6,197.23
July 1, 1891, balance unexpended	9,460.98
July 1, 1891, outstanding liabilities	466.67
July 1, 1891, balance available	8,994.31
Amount (estimated) required for completion of existing project	37,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 4.)

5. *Clark River, South Carolina.*—This river forms the southern mouth of Lynch's River. Its upper end was entirely choked by driftwood and fallen trees. The project provides for closing the northern mouth of Lynch's River and snagging Clark River. The estimated cost is $7,500.

The river and harbor act of September 19, 1890, appropriated $2,500 for this river, it being the second appropriation.

No work has been done, as the funds available were small and the water has been too high for cheap work.

The total expenditures, including June 30, 1891, have been $2,738.32.

July 1, 1890, balance unexpended	$36.07
Amount appropriated by act approved September 19, 1890	2,500.00
	2,536.07
June 30, 1891, amount expended during fiscal year	274.39
July 1, 1891, balance unexpended	2,261.68
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 5.)

6. *Mingo Creek, South Carolina.*—This stream was much obstructed by snags and overhanging trees. The project provides for removing obstructions from the mouth to Williams Landing for steamboat navigation, and above for pole-boat navigation. The estimated cost is $17,000.

During the year the creek has been snagged from the mouth to Williams Landing. The annual commerce amounts to $1,048,900. The total expenditures to June 30, 1891, were $6,922.33.

July 1, 1890, balance unexpended	$1,068.28
Amount appropriated by act approved September 19, 1890	5,000.00
	6,068.28
June 30, 1891, amount expended during fiscal year	2,990.61
July 1, 1891, balance unexpended	3,077.67
July 1, 1891, outstanding liabilities	259.32
July 1, 1891, balance available	2,818.35
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 6.)

7. *Santee River, South Carolina.*—This river was obstructed by sunken logs and snags. Its bar entrance was narrow, crooked, and shifting, with only about 4 feet depth at low tide, and so situated as to be difficult and expensive to improve. The total final cost of this work was estimated in 1886 at $346,500, of which $251,300 was for Mosquito Creek and $75,200 for the Santee River proper. In 1889 the project was modified, leaving the Mosquito Creek Canal, which had been completed for about $100,000, as a lumber route, and providing for a new cut between Estherville and Minim Creek, at an estimated cost of $250,000, and for completely snagging the Santee River itself, at a cost of $100,000. During the past year the flood gate in Mosquito Creek Canal was nearly completed. Dredging on the new cut between Estherville and Minim Creek began, and most of the rice drainage injured by this cut had been restored, as required by the right of way, at the close of the fiscal year. Up to June 30, 1891, $102,859.12 had been spent upon this improvement, giving a passage 30 feet wide, 5 feet deep at high water, from Santee River to Winyaw Bay; in building a drawbridge over Mosquito Creek, in accordance with the provision of the cession of the right of way, and in replacing rice drainage injured by digging the canal. The effect of this work upon the rice interests in the neighborhood has been and will be beneficial rather than detrimental.

July 1, 1890, balance unexpended		$5,257.66
Amount appropriated by act approved September 19, 1890		30,000.00
		35,257.66
June 30, 1891, amount expended during fiscal year		8,366.78
July 1, 1891, balance unexpended		26,890.88
July 1, 1891, outstanding liabilities	$1,950.29	
July 1, 1891, amount covered by uncompleted contracts	23,821.12	
		25,771.41
July 1, 1891, balance available		1,119.47
Amount (estimated) required for completion of existing project		320,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix M 7.)

8. *Wateree River, South Carolina.*—This river had a low-water depth of from 3 to 4 feet from its mouth in the Santee upward 67 miles to Camden, its practicable limit of steam navigation. The river was much obstructed by sunken logs and stumps, and was blocked by the bridges of the South Carolina, and Wilmington, Columbia and Augusta railroads, without draws. The original project proposed to secure a safe and unobstructed 4-foot navigation over this entire distance at all stages of water. Up to June 30, 1891, $46,359.61 had been spent upon this improvement, giving a good 4-foot navigation at all stages of water from the mouth to Camden. The railroad bridges have been supplied with draws. The appropriation of September 19, 1890, completes the original estimated cost, and for this sum the river has been put in a satisfactory condition. The engineer in charge reports that an annual appropriation of $5,000 is needed for snagging to keep the river in its present satisfactory condition.

July 1, 1890, balance unexpended		$7,729.28
Amount appropriated by act approved September 19, 1890		12,500.00
		20,229.28
June 30, 1891, amount expended during fiscal year		6,588.89
July 1, 1891, balance unexpended		13,640.39
July 1, 1891, outstanding liabilities		451.77
July 1, 1891, balance available		13,188.62
Amount that can be profitably expended in fiscal year ending June 30, 1893		6,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix M 8.)

9. *Congaree River, South Carolina.*—This river had a low-water depth of from 3 to 4 feet from its mouth 48 miles upward to the railroad bridge at Columbia, and thence a 1-foot low-water depth 2 miles further to its head, the navigation of the lower 47 miles from the mouth to Granby being blocked at all stages of water by the South Carolina Railroad Bridge without a draw, and by sunken logs, snags, overhanging trees, etc. The navigation of the upper 3 miles above Granby was prevented by swift current and numerous rock ledges and bowlders. The project proposes to secure a thoroughly cleared channel 4 feet deep at all stages below Granby, and a cleared channel 100 feet wide through the shoals above.

Work has been carried on between Granby and the mouth. Much good has resulted.

Up to June 30, 1891, $17,424.81 has been spent on this improvement, giving a thoroughly well-cleared navigation 70 feet wide and 4 feet deep at low water over the entire river below Granby. The South Carolina Railroad has put a proper draw-span in their bridge.

July 1, 1890, balance unexpended	$2,089.01
Amount appropriated by act approved September 19, 1890	5,000.00
	7,089.01
June 30, 1891, amount expended during fiscal year	4,513.82
July 1, 1891, balance unexpended	2,575.19
July 1, 1891, outstanding liabilities	647.74
July 1, 1891, balance available	1,927.45
Amount (estimated) required for completion of existing project	34,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 9.)

10. *Charleston Harbor, South Carolina.*—The work in progress since 1878 comprises two jetties of riprap with a mattress hearting wherever deemed advantageous resting upon a mattress of logs and brush. The two jetties spring from Sullivan and Morris Islands and converge on curves in such a manner as to cross the bar on parallel lines about 2,900 feet apart. They are to establish and maintain a channel across the bar of not less than 21 feet depth at mean low water where heretofore the low-water depth has not exceeded 12 feet. The total estimated cost for jetties up to low water is $4,380,500; for jetties up to 3 feet above mean low water, $5,334,500.

Work on the jetties continued till February 12, 1891, under the contract of Grant & Egan, 24,873 tons of riprap having been deposited on the south jetty outside of the Main Ship Channel, 13,541 tons in Main Ship Channel, and 4,850 tons on the shore end. Since February 12, 1891, work has been done under two contracts with Mr. Jacob Friday. Under one contract for stone below low-water level 6,066 tons of rock have been deposited on the South Jetty near the outer end, bringing this portion of the jetty up to low-water mark, and 6,211 tons inside of the Main Ship Channel, reënforcing the jetty where it was somewhat narrow and lightly ballasted. The price at both places is $1.90 a ton for stone in place. Under the other contract the North Jetty has been brought up to high-water mark, from 8,100 feet to 9,150 feet from the shore end, 9,213 tons of stone having been deposited, at $2.15 a ton, in place.

During the year, 16,688 tons of rock have been quarried and 16,287 tons deposited on the North Jetty by the United States plant and hired labor.

Dredging under the contract of Byron Clark Howell was resumed on July 7, 1890, and continued without serious intermission until November 8, 1890, when the plant was attached for debt and was not allowed to resume work before the end of the fiscal year.

A self-loading, self-propelling pump dredge, of 225 cubic yards' carrying capacity, was built for this improvement during the year by the United States, but was not completed in time to do any work before June 30, 1891.

The annual survey shows marked deepening over the whole area between the jetties, and a 12-foot channel at low water exists nearly all the way through across the bar. No material changes in the condition

of the jetties are reported, except such as are due to work done during the year.

Morris Island has not cut away seriously. On Sullivan Island no marked changes have occurred. The two spur jetties built in 1884 for the protection of a portion of the shore of Mount Pleasant are in good condition. The construction of a breakwater along this shore is delayed only till the right of way is approved by the Department of Justice, $5,000 having been specifically provided in the river and harbor act of September 19, 1890, for this purpose.

The total expenditures have been $1,894,447.61.

July 1, 1890, balance unexpended		$233,900.32
Amount appropriated by act approved September 19, 1890		370,000.00
		603,900.32
June 30, 1891, amount expended during fiscal year		295,847.93
July 1, 1891, balance unexpended		308,052.39
July 1, 1891, outstanding liabilities	$34,987.12	
July 1, 1891, amount covered by uncompleted contracts	231,937.67	
		266,924.79
July 1, 1891, balance available		41,127.60
Amount (estimated) required for completion of existing project		2,178,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		750,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix M 10.)

11. *Ashley River, South Carolina.*—Ashley River is about 40 miles in length and runs in a generally southeasterly direction. At its mouth the city of Charleston occupies the left bank. The plan of improvement comprises the removal of a shoal at a place named Accabee, about 8 miles above the city of Charleston, where, according to a survey made in 1873, there was then only 9 feet of water at low tide, and the removal of a shoal just below the Wando Phosphate Works, where only 6 feet of water was found at low tide. It was proposed to increase the draft of water over these shoals by dredging to a depth of from 10 to 11 feet at mean low tide, at an estimated cost of $5,000. Of four appropriations made for this work, the past three, aggregating $4,500, were expended in improving the river at the places indicated, obtaining low-water depth of from 10 to 11 feet on width of from 100 to over 200 feet. This satisfactory condition of the river has continued during the past fiscal year, for which reason the last appropriation of $1,000 made by act approved August 5, 1886, was largely held in reserve until it should appear expedient or necessary to expend it. It is reported that the value of its commerce has increased by $515,000 and the tonnage by 45,200 tons. The bridge of the Charleston Bridge Company, across this river, near Charleston, has been modified so as to afford better facilities for navigation during the year.

The total expenditures to June 30, 1891, were $4,673.66.

July 1, 1890, balance unexpended	$846.00
June 30, 1891, amount expended during fiscal year	19.66
July 1, 1891, balance unexpended	826.34

(See Appendix M 11.)

12. *Wappoo Cut, South Carolina.*—Wappoo Cut is a narrow, crooked, tidal stream, separating James Island from the main land and connecting Stono and Ashley rivers. Parts of it were originally very shallow.

The project comprises securing a channel 60 feet wide and 6 feet deep at low water by dredging, training walls at the Stono River entrance, revetting the banks of Elliott Cut with stone, making another cut through the marsh, constructing three more closing dams, and dredging Ashley River Bar. There is now a continuous 6-foot channel through from Ashley to Stono River at low water. The total expenditures to June 30, 1891, have been $40,413.77.

July 1, 1890, balance unexpended	$1,646.00
Amount appropriated by act approved September 19, 1890	10,000.00
	11,646.00
June 30, 1891, amount expended during fiscal year	9,059.77
July 1, 1891, balance unexpended	2,586.23
Amount (estimated) required for completion of existing project	45,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	45,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix M 12.)

13. *Edisto River, South Carolina.*—The Edisto River is formed by the junction of the North and South Forks, which unite in the southern part of Orangeburg County. The stream was very much obstructed by numerous bends, snags, overhanging trees, piles, and shoals, generally of sand, but in some places of hard clay and rock. The plan of improvement contemplates the establishment of a channel available at all seasons of the year for rafts and flatboats from the sea 260 miles to Guignard Landing on the South Fork. It embraces shutting off lateral arms of the river, removing shoals, snags, logs, piles, and other obstructions. The cost is estimated at $33,385.

The river and harbor act of September 19, 1890, provides $5,000 to be spent equally in the North and South Forks, which changes the scope of the project. The money spent on the North Fork should not be charged against the original estimate.

A large number of snags, logs, overhanging trees, and piles have been removed, and several sucks have been opened and others closed, thus confining the river to one channel. This work has materially benefited navigation by shortening the time and reducing the expense of trips. The work done during the year has been mostly on the two forks.

The total expenditures to June 30, 1891, were $21,806.75.

July 1, 1890, balance unexpended	$336.50
Amount appropriated by act approved September 19, 1890	5,000.00
	5,336.50
June 30, 1891, amount expended during fiscal year	1,143.25
July 1, 1891, balance unexpended	4,193.25
July 1, 1891, outstanding liabilities	1,014.63
July 1, 1891, balance available	3,178.62
Amount (estimated) required for completion of existing project	7,385.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,385.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix M 13.)

14. *Salkahatchie River, South Carolina.*—The Salkahatchie River rises in Aiken County, S. C., and flows into the Atlantic Ocean. The lower part of the river is known as the Combahee. Above a point known as Hickory Hill the river was obstructed at numerous places by piles, logs, trees, and sand bars. The project of improvement contemplated the creation of a continuous channel suitable for rafts and flatboats from a point 5 miles above Toby Bluff to Hickory Hill. The cost was estimated at $18,000.

The work done comprised thoroughly clearing the lower 12 miles of Salkahatchie River between Hickory Hill and the Charleston and Savannah Railroad Bridge, and improving the reaches from that bridge to Broxton Bridge. A substantial improvement of the river is reported.

The river and harbor act of September 19, 1890, provided $5,000 for this river, completing the estimated cost. No further funds will be required, the improvement being completed so nearly that the funds last appropriated will be sufficient for its maintenance.

The total expenditures to June 30, 1891, were $13,475.20.

July 1, 1890, balance unexpended	$245.15
Amount appropriated by act approved September 19, 1890	5,000.00
	5,245.15
June 30, 1891, amount expended during fiscal year	720.35
July 1, 1891, balance unexpended	4,524.80
July 1, 1891, outstanding liabilities	5.60
July 1, 1891, balance available	4,519.20

(See Appendix M 14.)

15. *Beaufort River, South Carolina.*—The portion of this river under improvement lies between Coosaw River and the town of Beaufort. It possessed a 7-foot channel nearly all the way through in places narrow, but for some distance had no more than 4 feet depth at low water.

The project provides for creating a through 7-foot channel of convenient width by dredging.

The first work ever done on this river by the United States was begun in June, 1891, 3,754 cubic yards having been dredged.

The total expenditures, including June 30, 1891, have been $603.17.

Amount appropriated by act approved September 19, 1890		$12,500.00
June 30, 1891, amount expended during fiscal year		603.17
July 1, 1891, balance unexpended		11,896.83
July 1, 1891, outstanding liabilities	$863.42	
July 1, 1891, amount covered by uncompleted contracts	10,136.58	
		11,000.00
July 1, 1891, balance available		896.83

Amount (estimated) required for completion of existing project	12,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M 15.)

16. *Removing sunken vessels or craft obstructing or endangering navigation.*—During the past fiscal year the removal of a wreck of a vessel, name unknown, loaded with guns and shot, from the South Channel across the Charleston, S. C., bar was completed.

(See Appendix M 16.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Wateree River, South Carolina, from Camden to the falls of the Catawba, also of the bend or curve in said river about 4 miles below Camden between the plantations of Witte and Williams to determine if it is advisable in the interest of navigation to make a cut off across the neck of said bend*, was made by the local engineer in charge, Captain Abbot, and report thereon submitted through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Abbot, and of the Division Engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 271, Fifty-first Congress, second session. (See also Appendix M 17.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN GEORGIA, AND OF CUMBERLAND SOUND, GEORGIA AND FLORIDA.

Officer in charge, Capt. O. M. Carter, Corps of Engineers, with Lieut. Thomas H. Rees, Corps of Engineers, under his immediate orders; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *Savannah River and Harbor, Georgia.*—The plan of improvement under which operations have been carried on in Savannah Harbor during the last fiscal year was approved by the Secretary of War on July 22, 1890. The project contemplates the establishment of a navigable channel 26 feet deep at mean high water between the city of Savannah and Tybee Roads. The mean rise and fall of tide varies from about 7 feet at Fort Pulaski to about 6 feet in front of the city wharves.

The estimated cost of the improvement is $3,500,000.

In 1873, prior to improvement, the channel was in places not more than 9 feet deep at mean low water, and the usual high-water draft of vessels was not more than 14.5 feet.

During the fiscal year just closed 72,178.84 square yards of log and brush mattresses and 26,160.5 cubic yards of stone have been used in the oyster-bed training wall. In the pile and brush work forming the closing dam at the Duck Puddle, the training wall below Spirit Island, and the spur dams protecting the banks at Elba Island and Jones Island there have been used 2,339 piles, 25,825.57 cubic yards of brush fascines, and 1,134.32 cubic yards of stone.

Between the ocean steamship wharves and Tybee Knoll 396,144.66 cubic yards of material have been removed by dredging. The expenditures during the year amounted to $212,148.91.

The total amount expended under the present project to June 30, 1891, including all outstanding liabilities, is $277,943.49.

There is now a navigable channel from the city to the sea with a least mean low-water depth of 14 feet, a gain of about 5 feet since the work was begun.

The real gain in navigable depth is somewhat greater than here shown, and vessels of from 20 to 21 feet draft now go from the city to the sea on a single tide.

The estimated reduction in freight rates, due to the improvements already executed, is 25 per cent., which effects an annual saving in freights alone of more than the total sum of money expended by the United States upon the harbor within the last 25 years.

July 1, 1890, balance unexpended		$4,035.05
Amount appropriated by act approved September 19, 1890		350,000.00
		354,035.05
June 30, 1891, amount expended during fiscal year		212,148.91
July 1, 1891, balance unexpended		141,886.14
July 1, 1891, outstanding liabilities	$65,794.58	
July 1, 1891, amount covered by uncompleted contracts	60,984.70	
		126,779.28
July 1, 1891, balance available		15,106.86
Amount (estimated) required for completion of existing project		3,150,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N 1.)

2. *Savannah River, Georgia.*—The present project for the improvement of this river was adopted in 1890, the object being to secure a low-water steamboat channel not less than 5 feet in depth between the cities of Augusta and Savannah, Ga.

The estimated cost of the improvement is $332,000. Prior to improvement navigation was much impeded by logs, snags, piles, and other obstructions. The depth at summer low water over some of the shoals did not exceed 2 or 3 feet.

The expenditures during the year amounted to $7,411.24. The total amount expended under the present project to June 30, 1891, including all outstanding liabilities, is $7,411.24, and has resulted in removing 354 snags, stumps, and logs, and 3,443 overhanging trees from the most troublesome places throughout the whole extent of river. Five trees were swung to bank and 24 logs were cut up on bank. The depth of water over the shoals near Augusta has increased during the year.

July 1, 1890, balance unexpended		$19.91
Amount appropriated by act approved September 19, 1890		25,000.00
		25,019.91
June 30, 1891, amount expended during fiscal year		7,411.24
July 1, 1891, balance unexpended		17,608.67
Amount (estimated) required for completion of existing project		307,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N 2.)

3. *Darien Harbor, Georgia.*—The plan of improvement under which operations have been carried on in Darien Harbor during the last fiscal year was adopted in 1885. The project contemplates the establishment of a navigable channel 12 feet deep at mean low water between Darien and Doboy. The mean rise and fall of tide is about 6.5 feet.

The estimated cost of the improvement is $170,000.

No work has ever been done under the existing project prior to the fiscal year just closed, during which 13,194.6 cubic yards of material were removed by dredging during the month of June.

The expenditures during the year amounted to $1,835.73. The total amount expended to June 30, 1891, including all outstanding liabilities, is $4,870.49, and has resulted in removing 13,194.6 cubic yards of material from the worst shoal in the harbor.

Amount appropriated by act approved September 19, 1890		$25,000.00
June 30, 1891, amount expended during fiscal year		1,835.73
July 1, 1891, balance unexpended		23,164.27
July 1, 1891, outstanding liabilities	$3,034.76	
July 1, 1891, amount covered by uncompleted contracts	16,965.24	
		20,000.06
July 1, 1891, balance available		3,164.27
Amount (estimated) required for completion of existing project		145,000.00
Amount that can be profitably expended in fiscal year edning June 30, 1893		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N 3.)

4. *Altamaha River, Georgia.*—The plan of improvement under which operations have been carried on upon the Altamaha River during the last fiscal year was adopted in 1890.

The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Darien and the junction of the Oconee and Ocmulgee rivers.

The estimated cost of the improvement is $129,000.

Prior to improvement navigation was much impeded by logs, snags, and other obstructions, the low-water depth at some points not exceeding 2 feet.

During the fiscal year just closed 150 snags, stumps, and logs, and 466 overhanging trees were removed; 4 trees were pulled back, and 2 logs were cut up on bank.

The expenditures during the year amounted to $1,946.79.

The total amount expended under the present project to June 30, 1891, including all outstanding liabilities, is $2,446.79, and has resulted in removing many of the most dangerous snags and overhanging trees.

July 1, 1890, balance unexpended		$223.41
Amount appropriated by act approved September 19, 1890		15,000.00
		15,223.41
June 30, 1891, amount expended during fiscal year		1,946.79
July 1, 1891, balance unexpended		13,276.62
July 1, 1891, outstanding liabilities		500.00
July 1, 1891, balance available		12,776.62
Amount (estimated) required for completion of existing project		114,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		45,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N 4.)

5. *Oconee River, Georgia.*—The plan of improvement under which operations have been carried on upon the Oconee River during the last fiscal year was adopted in 1890.

The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Milledgeville and the mouth of the river.

The estimated cost of the improvement is $171,000.

Prior to improvement navigation was much impeded by sand bars, overhanging trees, snags, and sunken logs. On some shoals there were low-water depths of not more than 2 feet. During the fiscal year just closed 1,135 logs, snags, and stumps, and 146 overhanging trees were removed, 600 cubic yards of stone were placed in a closing dam at

Fish Trap Cut, and 19 piles were driven and 11 brush mats sunk at Old Boat Yard in constructing contracting works at that point.

The expenditures during the year amounted to $8,120.31. The total amount expended under the present project to June 30, 1891, including all outstanding liabilities, is $8,120.31, and has resulted in so improving the river that boats now run at a stage of water 4 feet lower than before improvements were begun.

July 1, 1890, balance unexpended		201.18
Amount appropriated by act approved September 19, 1890		25,000.00
		25,201.18
June 30, 1891, amount expended during fiscal year		8,120.31
July 1, 1891, balance unexpended		17,080.87
July 1, 1891, amount covered by uncompleted contracts		8,010.00
July 1, 1891, balance available		9,070.87
Amount (estimated) required for completion of existing project		146,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix N 5.)

6. *Ocmulgee River, Georgia.*—The plan of improvement under which operations have been carried on upon the Ocmulgee River during the last fiscal year was adopted in 1890. The project contemplates the establishment of a steamboat channel 3 feet in depth at ordinary summer low water between Macon and the mouth of the river.

The estimated cost of the improvement is $210,000.

Prior to improvement navigation was much impeded by rock shoals, sand bars, overhanging trees, snags, and sunken logs, the low-water depth at some places not exceeding 2 feet.

During the fiscal year just closed 173 snags and logs, 13 stumps, and 520 overhanging trees were removed, 8 trees were deadened, and 14 logs cut up on the river bank. The expenditures during the year amounted to $12,575.89. The total amount expended to June 30, 1891, including all outstanding liabilities, is $13,099.69, and has resulted in removing many dangerous obstructions, boats now being able to run without accident at a stage of water some 3 feet lower than before the improvements were begun.

July 1, 1890, balance unexpended		$244.95
Amount appropriated by act approved September 19, 1890		30,000.00
		30,244.95
June 30, 1891, amount expended during fiscal year		12,575.89
July 1, 1891, balance unexpended		17,669.06
July 1, 1891, outstanding liabilities	$523.80	
July 1, 1891, amount covered by uncompleted contracts	5,340.00	
		5,863.80
July 1, 1891, balance available		11,805.26
Amount (estimated) required for completion of existing project		180,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix N 6.)

7. *Brunswick Harbor, Georgia.*—The plan of improvement under which operations have been carried on in Brunswick Harbor during the last fiscal year was adopted in 1880 and modified and enlarged in 1886.

The project contemplates the establishment of a navigable channel not less than 15 feet deep at mean low water. The mean rise and fall of tide is 6.8 feet.

The cost of the project of 1880 was estimated at $73,187.50, and as enlarged in 1886 at $190,000, inclusive of appropriations already made.

In 1880, prior to improvement, the channel was not more than 9 feet deep at mean low water.

During the fiscal year just closed 7,976.48 cubic yards of brush fascines and 1,737.93 cubic yards of stone were placed in the training wall.

The expenditures during the year amounted to $20,209.88. The amount expended to June 30, 1891, including all outstanding liabilities, is $147,667.61, and has resulted in securing a navigable low-water channel not less than 15 feet deep.

July 1, 1890, balance unexpended	$42.27
Amount appropriated by act approved September 19, 1890	35,000.00
	35,042.27
June 30, 1891, amount expended during fiscal year	20,209.88
July 1, 1891, balance unexpended	14,832.39
July 1, 1891, amount covered by uncompleted contracts	12,000.00
July 1, 1891, balance available	2,832.39
Amount (estimated) required for completion of existing project	27,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	27,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 7.)

8. *Jekyl Creek, Georgia.*—The plan of improvement under which operations have been carried on in Jekyl Creek during the last fiscal year was adopted in 1888. The project contemplates the establishment of a navigable channel through the creek 7 feet deep at mean low water. The mean and rise and fall of tide is about 7.1 feet.

The estimated cost of the improvement is $38,590.

Prior to improvement the low-water depth at some places did not exceed 3 feet.

During the fiscal year just closed a foundation course of training wall, 514.5 feet in length and 40 feet in width, was constructed at the mouth of the creek. There were used 2,282.22 square yards of log and brush mattresses, 28.17 cubic yards of brush fascines, and 336.18 cubic yards of stone. The expenditures during the year amounted to $3,919.60. The amount expended to June 30, 1891, including all outstanding liabilities, is $8,838.22, and has resulted in securing a navigable channel with a low-water depth of not less than 5 feet.

July 1, 1890, balance unexpended	$31.38
Amount appropriated by act approved September 19, 1890	7,500.00
	7,533.80
June 30, 1891, amount expended during fiscal year	3,919.61
July 1, 1891, balance unexpended	3,611.78
July 1, 1891, amount covered by uncompleted contracts	3,000.00
July 1, 1891, balance available	611.78
Amount (estimated) required for completion ofexisting project	26,090.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	26,090.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N 8.)

9. *Cumberland Sound, Georgia and Florida.*—The plan of improvement under which operations have been carried on at Cumberland Sound during the last fiscal year was adopted in 1879, and revised in 1891. The project contemplates the establishment of a navigable channel across the bar 19 feet deep at mean low water. The mean rise and fall of tide is 5.9 feet. The estimated cost of the improvement is $2,079,500, exclusive of work done prior to 1891.

Prior to improvement the low-water depth of the entrance varied from 11 to 12.5 feet, with a mean rise and fall of tide of 5.9 feet.

During the fiscal year just closed there were placed in the north jetty 2,769.35 square yards of brush mattresses and 382.38 cubic yards of stone, extending the foundation course 267.4 feet. The expenditures during the year amounted to $4,775.95. The total amount expended to June 30, 1891, including all outstanding liabilities, is $488,347.

July 1, 1890, balance unexpended		$449.72
Amount appropriated by act approved September 19, 1890		112,500.00
		112,949.72
June 30, 1891, amount expended during fiscal year		4,775.94
July 1, 1891, balance unexpended		108,173.78
July 1, 1891, outstanding liabilities	$4,020.78	
July 1, 1891, amount covered by uncompleted contracts	90,979.22	
		95,000.00
July 1, 1891, balance available		13,173.78
Amount (estimated) required for completion of existing project		1,967,000.00
Amount that can be profitably expended in fiscal year ending June 20, 1893		1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix N 9.)

10. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wrecks of the steamers *Habersham* and *General Lee*, together with some other vessels and barges sunk during the revolutionary and civil wars, were, after due advertisement, removed by contract during the year.

(See Appendix N 10.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Yellow River, Georgia, from the railroad bridge near Covington to the Ocmulgee, with a view of obtaining a steamboat channel of 5 feet deep at mean low water*, was made by the local engineer in charge, Captain Carter, and report thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Carter, and of the Division Engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. (See Appendix N 11.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Carter, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Carter, and of the Division Engineer, based upon the facts and reasons

given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Captain Carter was charged with their survey, the reports on which will be submitted when received.

1. *The inside route between Savannah, Georgia, and Fernandina, Florida, with a view of obtaining a steamboat channel of 7 feet depth at mean low water.*

2. *The inside route between Doboy and Sopelo [Sapelo], Georgia, with a view of making the same navigable for sea-going vessels.*

3. *Brunswick Outer Bar, Georgia, to determine the feasibility and cost of deepening the same to 26 feet at ordinary high water.*

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN FLORIDA.

Officer in charge, Capt. W. M. Black, Corps of Engineers, with Lieut. D. DuB. Gaillard, Corps of Engineers, under his immediate orders; Division Engineer, Col. Wm. P. Craighill, Corps of Engineers.

1. *St. John's River, Florida.*—Operations for the improvement of this river have been carried on in conformity with a project submitted in 1879 by the late General Gilmore, Colonel, Corps of Engineers. The plan contemplates the formation of a continuous channel 15 feet deep at mean low water from Jacksonville to the ocean. The points where work is required are in a reach near Dame Point, 12 miles from the mouth, and on the bar at the mouth. Near Dame Point the mean low-water depth varies from 12 to 13 feet, with a tidal range of 1 to 2 feet. The bar at the mouth is formed of sand. Before work began the mean low-water channel depth across it varied from 5 to 7 feet, with a tidal range of 5.8 feet. The channel across the bar shifted continuously north and south through a mile range. The work was divided into two parts: (1) The formation of a channel across the bar at the mouth, by the concentration and direction of the tidal currents by two jetties, to start from the opposite shores of the entrance, and to converge, until, on the bar, their outer ends should be approximately parallel and 1,600 feet apart; and (2) the improvement of the Dame Point Reach, by dredging, and the construction of works of protection, under a project approved June 11, 1891.

As the improvement at the mouth was at first most urgently needed, the five appropriations up to that of 1886, inclusive, aggregating $675,000, were made for improving "the channel over the bar at the mouth," under the estimate for that part of the total project. Since 1887 the depth on the bar has been greater than that in the Dame Point Reach, and the interests of commerce have demanded that work at the latter point should be started. Accordingly, the appropriations since 1888 were made for improving the river "from Jacksonville to the ocean, including the channel over the bar at the mouth," under the estimate for the entire project.

At the close of the fiscal year 1889–'90, $828,065.21 had been expended. The south jetty had a total length of 7,147 feet. Of this 1,740 were at the full height and capped; 2,740 were built to the height of mean low water, but with insufficient width of crest; for 800 feet further the average low-water depth on the crest was 1 foot; for the remaining distance the jetty crest was about 5 feet below mean low water. The total length of the north jetty was 9,048 feet. Of this 553 feet were built to full height and capped; 6,404 feet were built up to mean low water, with insufficient width of crest; the mean low-water depth over the remaining length averaged 1 to 5 feet. Prior to 1886 the jetties were built of alternate layers of mattresses and rock. Since

that date mattresses have been used in the foundation course only. A survey of the Dame Point Reach was made in 1889.

Work by contract, under the appropriation of 1890, was begun in February, 1891. Since that date 12,976.8 tons of rock and 14,783 square yards of brush mattresses have been placed in the jetties. The south jetty superstructure has been raised to the level of mean low water for 1,000 feet. The north jetty foundation has been extended 1,117 feet and its superstructure built up for 236 feet.

In October and November, 1890, a small amount of dredging was done in the north channel over the bar and in the Dame Point Reach. Other work during the year included the construction of a storehouse and wharf and the construction of wings to the south jetty shore extension.

During the year the favorable action of the jetties has continued. The 12-foot contour of the north channel was pushed seaward 2,100 feet. It is now distant only 700 feet from the outer 12-foot contour of the bar, with a minimum channel depth of 10 feet at mean low water between. The south jetty channel is also improved. The mean low-water depth over the inner bar is now 11.5 feet and over the outer bar 13 feet, as against 8.9 and 11.2 feet of last year, with a straighter channel. Ward Bank, between the jetties, has entirely disappeared.

July 1, 1890, balance unexpended		$23,094.51
Amount appropriated by act approved September 19, 1890		170,000.00
		193,094.51
June 30, 1891, amount expended during fiscal year		38,241.50
July 1, 1891, balance unexpended		154,853.01
July 1, 1891, outstanding liabilities	$18,213.57	
July 1, 1891, amount covered by uncompleted contracts	106,979.91	
		125,193.48
July 1, 1891, balance available		29,659.53
Amount (estimated) required for completion of existing project		602,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix O 1.)

2. *Oclawaha River, Florida.*—The portion of the Oclawaha River which it is proposed to improve lies between Leeburg on Lake Griffin and the mouth, a distance of 94 miles. The channel width varies from 30 to 70 feet and the depth from 5 to 9 feet. From the outlet of Lake Griffin, for a distance of 28 miles, the river is sluggish in current, has numerous bends, and is badly obstructed by floating islands and grass. For the remaining 58 miles the current is strong and the principal obstructions are snags and overhanging trees. An appropriation of $10,000 was made in the act approved September 19, 1890, for improving the river. A portion was spent on making a survey and map and in preparing a project. The remainder will be expended in removing the obstructions.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	2,455.68
July 1, 1891, balance unexpended	7,544.32
July 1, 1891, outstanding liabilities	33.42
July 1, 1891, balance available	7,510.90

Amount (estimated) required for completion of existing project	$7,510.90
Amount that can be profitably expended in fiscal year ending June 30, 1893, for maintenance	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 2.)

3. *Volusia Bar, Florida.*—Volusia Bar is situated at the head of Lake George, and is formed by materials brought down by the St. Johns River and deposited at the point where the current of the narrow river loses its velocity as the bed widens to form the lake. The usual depth on the bar, before operations began, was from 3½ to 4½ feet, with a very crooked channel. At times this depth was diminished so much as to stop navigation entirely.

The adopted plan of improvement was to contract the waters on the bar by the construction of two converging jetties formed of brush and stone, with a view to causing a scour to the depth of 6 feet. Should the depth caused by the jetties not be sufficient, recourse was to be had to dredging. Between the jetties on the bar lines of guide piles were placed to keep vessels off the jetties and to define the channel clearly.

In 1887 it was decided to limit the channel depth sought to the 5 feet then obtained, on account of the evident shoaling in the lake beyond the jetties, and because that depth was sufficient for the requirements of the existing river commerce.

Up to June 30, 1890, $25,481.77 had been expended, including liabilities then outstanding. The jetties had been built to their full length and to a height sufficient to produce the desired effect; two lines of firmly set fender-piles defined the jetty channel on the crest of the bar, and a straight channel with a minimum mean low-water depth of 5 feet had been obtained. In the spring of 1890 the crests of both jetties were found to have been lowered slightly, and several gaps had been made through them to a depth of 4 feet in one place. One hundred cubic yards of rock were placed on the jetties filling the lowest places.

In December, 1889, one of the river steamers broke out one of the panels of the west pile-fender line. This has not been repaired. During the past low-water season the channel depth at the end of the jetties fell to 4.6 feet, and commerce was greatly delayed. The amount available will be used for raising low places in the jetties. The officer in charge reports that on account of the shoalness of the lake beyond the jetties any further increase of depth should be attained by dredging from time to time as may be required. He states that this will require an annual outlay of $500, provided a contract can be made for the work. As it is very difficult to obtain dredging plant in this vicinity, he recommends the construction of a suitable dredge for use here and in the Upper St. Johns River (for the improvement of which there remains an unexpended appropriation of $4,930), at a cost of $15,000.

July 1, 1890, balance unexpended	$45.48
Amount appropriated by act approved September 19, 1890	500.00
	545.48
June 30, 1891, amount expended during fiscal year	41.35
July 1, 1891, balance unexpended	504.13
July 1, 1891, outstanding liabilities	168.75
July 1, 1891, balance available	335.38

Amount (estimated) required annually for maintenance of existing project	$1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 3.)

4. *Harbor at St. Augustine, Florida.*—The approved project is to protect the shores from erosion, by the construction of groins of concrete and riprap on brush foundation mattresses.

Two appropriations aggregating $55,000 have been made for this harbor, and have been expended in accordance with this project.

Work under the first appropriation was begun in October, 1889, and ended in September, 1890.

Work under the second appropriation was commenced in December, 1890, and ended in May, 1891.

Five groins in all have been built; one 341 feet long and another 523½ feet long, on Anastasia Island, near the light-house; one 548.9 feet long, one 465 feet long, and one 415 feet long, on North Beach, near the point.

They have all been successful in their operation and have built out the shore line in their vicinities.

To complete the protection now contemplated, the engineer officer in charge states that but $10,000 (the difference between his estimate of May 24, 1890, and the amount appropriated) will be needed, in addition to the amount now on hand.

July 1, 1890, balance unexpended	$1,682.14
Amount appropriated by act approved September 19, 1890	20,000.00
	21,682.14
June 30, 1891, amount expended during fiscal year	17,570.02
July 1, 1891, balance unexpended	4,112.12
July 1, 1891, outstanding liabilities	149.68
July 1, 1891, balance available	3,962.44

Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 4.)

5. *Northwest entrance, Key West Harbor, Florida.*—A bar having a channel depth of 10.5 feet obstructs the northern entrance to this harbor. During storms the available depth is so much reduced that vessels bound to and from Gulf ports can not use it, but are compelled to make a detour of about 100 miles by Dry Tortugas to enter or leave the Gulf.

An examination of the entrance with a view to its improvement was made in 1867 and again in 1881. In 1882 Congress made an appropriation of $25,000 for dredging a channel 300 feet wide and 17 feet deep across the bar. As was anticipated, the improvement was only temporary.

In the act approved August 5, 1886, $2,500 was appropriated for a new examination and survey of the bar. This was made in December, 1886, and January, 1887. The bar was found to be formed and maintained by interfering tidal currents. The project for its improvement comprised the construction of one or more training walls, with dredging, if necessary.

In the act of August 11, 1888, Congress appropriated $25,000 for this work, with the proviso that the Secretary of War should appoint a board of three engineer officers, who should consider the subject and report on the advisability of continuing the work under the above project, and that he should submit the report, together with the views of himself thereon, to Congress at its next session.

The final report of the Board was submitted in November, 1889, and printed as a part of Appendix P 4, Report of the Chief of Engineers, 1890. The board was of the opinion that the work is of national importance. It recommended that the improvement be begun by the immediate construction of a jetty along the northeast side of the entrance.

The report further states:

> After this northeastern jetty is constructed, and from its effects a better judgment than is now possible can be formed as to what further work is expedient, * * * a second jetty on the west side of the bar channel, as recommended, * * * may become necessary after the one on the easterly side is constructed. * * * It may become desirable to supplement jetties by dredging, and the project contemplates such work.
>
> The estimated cost of the construction of the northeastern jetty above recommended is about $500,000. That this expenditure will materially improve navigation over the worst portion of the existing bar channel, and will indicate the direction and extent to which further works may profitably be carried, can hardly be doubted.

Up to the close of the fiscal year ending June 30, 1890, $10,408.37 had been expended in the surveys and for the expenses of the Board of Engineers. An appropriation of $40,000 was made for the improvement in the act approved September 19, 1890. Proposals for the work were opened November 29, and a contract for carrying on the work was made. The contractor has been much hampered by difficulties attending the beginning of a new work in a new and distant locality. Up to June 30 only 1,160.3 cubic yards of rock had been placed in the jetty.

July 1, 1890, balance unexpended		$17,091.63
Amount appropriated by act approved September 19, 1890		40,000.00
		57,091.63
June 30, 1891, amount expended during fiscal year		1,179.30
July 1, 1891, balance unexpended		55,912.33
July 1, 1891, outstanding liabilities	$2,555.93	
July 1, 1891, amount covered by uncompleted contracts	47,795.43	
		50,351.36
July 1, 1891, balance available		5,560.97
Amount (estimated) required for completion of existing project		460,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		460,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix O 5.)

6. *Caloosahatchee River, Florida.*—Before improvement the lower part of the river was so obstructed by oyster bars that the available channel depth was only 5½ feet. About 17 miles above the mouth the river loses the characteristics of an estuary, and there are numerous islands and a broad shoal.

The project adopted in 1882 called for the formation, by dredging, of a channel 100 feet wide and 7 feet deep, from the bay to Fort Myers, a distance of 17 miles. In 1886 this project was modified so as to include the improvement of the upper river as far as Fort Thompson by removal of snags and overhanging trees.

Up to June 30, 1890, $22,432.07 had been expended on the improvement. A channel 6 feet deep and 100 feet wide existed between the mouth and Fort Myers. A narrow cut, 5 feet deep, had been made through the shoals at Beautiful Islands and partially protected by a training wall, and the worst obstructions had been removed from the river as far as Fort Thompson.

Three thousand six hundred dollars were appropriated in the act of September 19, 1890, for completing the improvement. With this sum the remaining obstructions were removed from the channel between Fort Thompson and the Beautiful Islands. The cut at the Beautiful Island shoal and its protecting dike were extended, and the channel through the oyster bars at the mouth of the river was enlarged and marked. When work stopped there was a clear channel from the mouth to Fort Thompson, having a mean low-water depth of 6 feet as far as Fort Myers and a depth of 4 feet for the remaining distance. An annual expenditure of $1,000 will be required to maintain this improvement.

July 1, 1890, balance unexpended	$3,845.47
Amount appropriated by act approved September 19, 1890	3,600.00
	7,445.47
June 30, 1891, amount expended during fiscal year	7,298.86
July 1, 1891, balance unexpended	146.61
July 1, 1891, outstanding liabilities	125.00
July 1, 1891, balance available	21.61
Amount (estimated) required for maintenance of existing project	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 6.)

7. *Channel of Charlotte Harbor and Pease Creek, Florida.*—The portion under improvement lies between the Boca Grande entrance from the Gulf of Mexico and the wharves at Punta Gorda, 2 miles from the mouth of Pease Creek. The available depth at the entrance is 19 feet at mean low water. Immediately within the entrance there is an anchorage, with a depth of 18 feet and over. Between that point and Punta Gorda, a distance of 24½ miles, the channel depth varies from 10 to 20 feet. In the act of September 19, 1890, $35,000 were appropriated for improving the channel between the limits named. Up to the close of the fiscal year $2,886.44 had been expended in making a survey of the defective portions of the channel, in preparing a project for its improvement and in making a contract for the work. Active operations under the contract have not yet been started. The approved project contemplates the immediate formation of a channel 12 feet deep and as wide as the funds will permit. The estimated cost of a channel 200 feet wide and 12 feet deep is $127,500; of a channel 200 feet wide and 15 feet deep, $468,000.

Amount appropriated by act approved September 19, 1890		$35,000.00
June 30, 1891, amount expended during fiscal year		2,886.44
July 1, 1891, balance unexpended		32,113.56
July 1, 1891, outstanding liabilities	$20.06	
July 1, 1891, amount covered by uncompleted contracts	29,500.00	
		29,520.06
July 1, 1891, balance available		2,593.50

(See Appendix O 7.)

8. *Sarasota Bay, Florida.*—The total length of Sarasota Bay is 34 miles. The portion under improvement extends from Tampa Bay to Sarasota, a distance of 21¼ miles. The general available channel depth is 5 feet, but there are two reaches, aggregating 1 mile in length, where the available channel depth varies from 3.5 to 4.3 feet. The approved project contemplates the formation of a channel 100 feet wide and 5 feet deep at mean low water between the limits named above. As it is most economical to do this work with the United States dredge *Suwanee*, operations have been postponed until her services should become available. It is expected that work will be started at an early date. The appropriation of $5,000 made for this work in the act approved September 19, 1890, is the first for the improvement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	273.00
July 1, 1891, balance unexpended	4,727.00
July 1, 1891, outstanding liabilities	255.00
July 1, 1891, balance available	4,472.00
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 8.)

9. *Manatee River, Florida.*—The portion of the Manatee River under improvement is the lowest reach, between Rocky Bluff and the mouth, a distance of about 12 miles. This had a midchannel depth of from 7 to 20 feet. The general width is about three-fourths of a mile. At the mouth was a long shoal with a minimum depth of 7 feet. Between Palmetto and Manatee, about 6 miles from the mouth, was another bar covered by from 3 to 5 feet of water.

The river was examined in 1881. The project adopted had for its object to form a channel 100 feet wide and 13 feet deep at mean low water from Tampa Bay to McNeil Point (Palma Sola). Owing to the changed commercial conditions since the adoption of the project, brought about by the extension of the railroad to Tampa, the transfer to Tampa of the principal gulf steamship lines, and the service of the smaller towns around Tampa Bay by coasting steamers from Tampa, the project was modified in 1886 to provide for the passage of these lighter-draft vessels to all of the towns of the lower river by the removal of the bar above Palmetto.

Up to the close of the fiscal year ending June 30, 1890, $27,808.13 were expended on this improvement. A dredged cut was made across the bar at the mouth of the river, another cut was made across the bar between Manatee and Braidentown, and a survey and map of the river were made. The cut at the mouth had been nearly obliterated, but a channel 8 feet deep and of sufficient width existed from Tampa Bay to Manatee. In the act approved September 19, 1890, $6,000 were appropriated for continuing the improvement. The amount was insufficient to make any permanent improvement in the channel at the mouth, the only place where work is now required, and the money available is held until required elsewhere in the river or until further appropriations shall increase it to a sum sufficient for economical work at the mouth.

July 1, 1890, balance unexpended	$191.87
Amount appropriated by act approved September 19, 1890	6,000.00
	6,191.87
June 30, 1891, amount expended during fiscal year	73.80
July 1, 1891, balance unexpended	6,118.07
July 1, 1891, outstanding liabilities	7.75
July 1, 1891, balance available	6,110.32
Amount (estimated) required for completion of existing project	39,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 9.)

10. *Tampa Bay, Florida.*—The harbor at Tampa, at the head of one arm of this bay, was separated from deep water by a flat 2 miles wide. Through this was a narrow channel with an average available depth of about 5 feet, formed by the waters of Hillsboro River.

The original project was adopted in 1879, and had for its object the formation of a 9-foot channel, 150 feet wide in the bay and 200 feet wide in the river, from the 9-foot curve in the bay to the wharves at Tampa, in Hillsboro River, at an estimated cost of $97,000.

Up to June 30, 1888, $69,068.54 had been expended. The work consisted entirely of dredging and rock excavation, and extended over a distance of 8,200 feet, making a cut varying in width from 200 feet in the river to 60 feet in the bay. On June 30, 1887, it had a depth along its center line of from 8.3 to 9 feet. The depth on the flats beyond the outer extremity of the cut is 7 feet. In 1888 the project was modified. Port Tampa, 9½ miles from Tampa, on Old Tampa Bay, had become the deep-water port of Tampa. The modified project is to form and maintain a channel 8 feet deep in Hillsboro Bay and Hillsboro River to the city of Tampa, and a channel 20 feet deep and 200 feet wide from the outer bar to Port Tampa. In the act of August 11, 1888, $25,000 was appropriated for work under this project. At the end of the fiscal year ending June 30, 1890, a cut had been started through the outer bulkhead at the entrance to Old Tampa Bay. The work, which was done under contract, had been greatly delayed and no useful result had been obtained. Work was continued under the contract until March 28, 1891. When operations stopped the cut through the outer bulkhead was 20 feet deep for a width of 100 feet and from 16 to 20 feet deep for the remaining width. The channel through the inner bulkhead had a mid-depth of 19.5 feet. In the act approved September 19, 1890, $25,000 were appropriated for continuing the improvement. A contract has been entered into for the work, under which operations will be started in August.

July 1, 1890, balance unexpended		$21,853.45
Amount appropriated by act approved September 19, 1890		25,000.00
		$46,853.45
June 30, 1891, amount expended during fiscal year		22,047.45
July 1, 1891, balance unexpended		24,806.00
July 1, 1891, outstanding liabilities	$52.75	
July 1, 1891, amount covered by uncompleted contracts	21,100.00	
		21,152.75
July 1, 1891, balance available		3,653.25

Amount (estimated) required for completion of existing project	$10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O 10.)

11. *Withlacoochee River, Florida.*—This river is 120 miles long and has a normal width varying from 75 to 180 feet, though at numerous points a defined channel is almost lost in broad marshy lakes and cypress swamps. The low-water depth varied from 1 to 7½ feet. Before improvement the river was so obstructed by loose rocks, snags, fallen trees, floating grass islands, and bars as to be practically impassable excepting in isolated reaches.

The river was examined with a view to its improvement in 1879. The approved project calls for the removal of snags, overhanging trees, loose rocks, and some of the worst shoals between the Gulf of Mexico and Pemberton Ferry, a distance of about 77 miles, so as to permit boats of 2-feet draft to navigate the river during one-half the year.

Up to June 30, 1890, $16,770.21 had been expended. The river was cleared and made navigable as called for by the project between Pemberton Ferry and Dunellan. More work will be required on some of the ledges before navigation is safe. Work is also required below Dunellan. There were no operations during the past fiscal year, as the services of the United States snag-boat were not available.

July 1, 1890, balance unexpended		$1,729.79
Amount appropriated by act approved September 19, 1890		5,400.00
		7,129.79
June 30, 1891, amount expended during fiscal year		1,089.62
July 1, 1891, balance unexpended		6,040.17
July 1, 1891, outstanding liabilities		36.05
July 1, 1891, balance available		6,004.12

(See Appendix O 11.)

12. *Harbor at Cedar Keys, Florida.*—The improvement of this harbor has been carried on from time to time under various appropriations made since 1872. It was obstructed by a shoal, known as the Middle Ground, lying in the main ship channel opposite Way Key and by shoals elsewhere in the channel and at its outer extremity. At these points the general channel depth of 12 feet was reduced to from 7 or 9 feet by outcropping rocks with sand and shells.

The existing project for the improvement has for its object to form a channel 200 feet wide and 10½ feet deep through these shoals. Work under this project has been carried on under various appropriations made since 1884. The total expenditure up to June 30, 1890, was $15,434.33. A clear channel of the required depth from the Gulf up to Cedar Keys had been obtained. Near Buoy 12, and in the middle ground, the width was insufficient. Operations under the existing contract were continued at the middle ground until July 26. When work stopped the cut there had a width of 200 feet and a least depth of 9.5 feet. Along its east side the depth was 10 feet. In the act approved September 19, 1890, $2,500 were appropriated for this harbor, with the provision that a portion could be expended at Derrick Island Gap on the inside channel from Suwanee River. As it is most economical to do the work contemplated under this appropriation with the United States snag boat *Suwanee*, no operations were possible until her services

should become available. It is proposed to start the work here in July, 1891.

July 1, 1890, balance unexpended	$6,917.74
Amount appropriated by act approved September 19, 1890	2,500.00
	9,417.74
June 30, 1891, amount expended during fiscal year	7,270.66
July 1, 1891, balance unexpended	2,147.08
July 1, 1891, outstanding liabilities	86.85
July 1, 1891, balance available	1,060.23
Amount (estimated) required for completion of existing project	44,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O 12.)

13. *Suwanee River, Florida.*—The length of river under improvement is 130 miles. From the Derrick Gap entrance to Branford, a distance of 80 miles, the width of the river varies from 250 to 300 feet, and its original low-water depth from 3 to 30 feet. It was but little obstructed excepting at the mouth. Between Branford and Ellaville the general width is 325 feet. It was obstructed by many dangerous rock shoals, crossed by crooked channels which had a low-water depth of from 1.5 to 3 feet, as well as by snags and overhanging trees.

A project for this improvement was adopted in 1880. It contemplates the formation of a channel 150 feet wide and 5 feet deep from the gulf (through the bars at the passes) as far up the river as New Branford (Roland Bluff). From there to Ellaville the channel is to be 60 feet wide and 4 feet deep.

Up to the close of the fiscal year ending June 30, 1890, $27,360.17 had been expended on this improvement. A long cut, now partly obliterated, had been made through the shoals between the mouth and deep water of the Gulf of Mexico, and a practicable, but not safe, channel had been opened as far as Hudson.

During the past fiscal year operations have been carried on by the U. S. snag boat *Suwanee*, and the channel between Branford and Luraville has been widened and deepened so that a channel safe during medium and high stages, and fairly safe and 3½ feet deep at the lowest stages, now exists as far as Hudson, 15 miles below Ellaville. Navigation is still obstructed by the shoals near the mouth and at the Derrick Gap entrance.

July 1, 1890, balance unexpended	$663.13
Amount appropriated by act approved September 19, 1890	3,000.00
	3,663.13
June 30, 1891, amount expended during fiscal year	2,340.20
July 1, 1891, balance unexpended	1,322.93
July 1, 1891, outstanding liabilities	689.42
July 1, 1891, balance available	633.51
Amount (estimated) required for completion of existing project	24,158.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O 13.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Black, and reports thereon submitted through Col. William P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Black, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *The upper part of the St. John's River, Florida, from Lake Monroe southward, or in a southerly direction through the river and connecting lakes to the head of steamboat navigation.*—Printed as House Ex. Doc. No. 240. (See also Appendix O 14.)

2. *St. John's River, Florida, from Jacksonville to Sanford, to obtain an estimate of the cost of deepening the channel so as to secure navigation for ocean steamers, and to report separately the cost of opening the channel of the river in the vicinity of Orange Mills.*—Printed as House Ex. Doc. No. 240. (See also Appendix O 14.)

3. *St. Augustine, Florida, for improvement of channel so as to make a deep sea channel over the outer and inner bars.*—Printed as House Ex. Doc. No. 291. (See also Appendix O 15.)

4. *Indian River, Florida, between Titusville and Jupiter Inlet.*—This river is not regarded as worthy of improvement by the General Government until the Florida Coast Line Canal and Transportation Company surrenders and relinquishes to the United States all the rights and privileges it now holds under State charter along the entire route. Printed as House Ex. Doc. No. 168. (See also Appendix O 16.)

5. *Channel lying north and west of the town of Cedar Keys, Florida, known as Boat or Number Four Channel.*—Printed as House Ex. Doc. No. 205. (See also Appendix O 17.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Black, and reports thereon submitted through Col. Wm. P. Craighill, Corps of Engineers, Division Engineer, Southeast Division. It is the opinion of Captain Black, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement as specified. The reports of the preliminary examinations containing sufficient information to indicate to Congress the probable cost of the work required, no further surveys appear to be necessary at this time.

1. *Peace [Pease] River, Florida.*—It is the opinion of Captain Black that Pease River is not worthy of improvement above Fort Ogden; that it is worthy of improvement below Fort Ogden; that there is no pressing necessity at present for the improvement between Fort Ogden and Punta Gorda; and that the improvement below Punta Gorda is necessary only in connection with the improvement of the channels through Charlotte Harbor, between Boca Grande entrance and Punta Gorda. The Division Engineer considers the river worthy of improvement below, but not above, Fort Ogden. Captain Black states that—

> With the appropriation of $35,000 made in the act approved September 19, 1890, the channel will be deepened at the mouth of the river as far as the railroad wharf at Punta Gorda. Should the railway be extended to the deep water at Boca Grande Pass, I do not deem a further improvement of the channel here necessary.

Report transmitted to Congress and printed as House Ex. Doc. No. 241, Fifty-first Congress, second session. (See also Appendix O 18.)

2. *Charlotte Harbor, Florida.*—The improvement proposed contemplates the formation of a channel at least 15 feet deep and 200 feet wide, from the Boca Grande entrance to Punta Gorda, at an estimated cost of $468,000. If, however, as is proposed, the railroad is extended from Punta Gorda to Boca Grande, it will be necessary only to dredge a channel 23 feet deep and 300 feet wide from the Gulf of Mexico to the anchorage within the Boca Grande entrance, at an estimated cost of $35,300. (See Appendix O 19.)

IMPROVEMENT OF CERTAIN RIVERS IN GEORGIA, FLORIDA, AND ALABAMA, AND OF APALACHICOLA BAY, AND HARBOR AT PENSACOLA, FLORIDA.

Officer in charge, Capt. Philip M. Price, Corps of Engineers, having under his immediate orders Lieut. Charles L. Potter, Corps of Engineers, to June 12, 1891, and Lieut. Wm. E. Craighill, Corps of Engineers, since June 1, 1891; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Apalachicola Bay, Florida.*—A bar existed at the mouth of the Apalachicola River, extending from one-half mile below the town of Apalachicola, Fla., to the lower anchorage. The minimum channel depth over this bar was 3½ feet.

In 1879 a plan of improvement was adopted which contemplated the dredging through the bar of a straight channel 11 feet deep and 100 feet wide, to be afterwards increased to 200 feet if the first cut should produce results that would warrant it.

Up to June 30, 1890, the sum of $85,009.63 had been expended on this improvement in dredging a straight channel through the bar at the mouth of the river, whenever funds were available, between the years 1881 and 1890. On account of inadequate appropriations the dredged cut has never exceeded 90 feet in width and 9½ feet in depth, and has gradually filled up, partly by the deposit of silt from the river, and partly by the washing in of material from the sides of the cut by the currents produced by the tides and the prevailing easterly winds.

The last dredging was completed in May, 1890, and at that time the channel was 8 feet in depth at mean low water, and had a maximum width of 90 feet. Since that time no dredging has been done.

During the fiscal year ending June 30, 1891, $3,529.38 has been expended in making a survey of the mouth of the river and of a part of the bay. The report of this survey was submitted on May 15, 1891, and showed that there had been an average shoaling of about 1½ feet in the dredged cut. It also appears from this survey that the Bulkhead Shoal, on which there is only 6 feet of water, now forms the most serious obstruction to the commerce of Apalachicola Bay. The recommendation of the officer in charge, that the funds now available should be expended in dredging a 9-foot channel through this shoal was therefore approved, and he was authorized to advertise for proposals for doing the work. The advertisement was published on June 10, 1891, and the proposals will be opened on July 15, 1891. If reasonable bids are received it is proposed to expend all of the available balance in this dredging. It is anticipated that by next year it will be essential, for the preservation of the commerce of Apalachicola Bay, to redredge the straight channel through the bar at the mouth of the river.

It is estimated that the cost of securing the approved channel of 100

feet in width and 11 feet in depth will be $60,000, and the work can be more economically accomplished if this sum is appropriated at one time.

July 1, 1890, balance unexpended	$1,990.62
Amount appropriated by act approved September 19, 1890	20,000.00
	21,990.62
June 30, 1891, amount expended during fiscal year	3,529.38
July 1, 1891, balance unexpended	18,461.24
July 1, 1891, outstanding liabilities	3.50
July 1, 1891, balance available	18,457.74
Amount that can be profitably expended in fiscal year ending June 30, 1893	60,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 1.)

2. *Apalachicola River, Florida, including Lee Slough.*—An examination and survey of the Apalachicola River was made in the winter of 1872–'73. The river was found to be obstructed by snags and overhanging trees. An accumulation of drift logs against piles driven by Confederate authorities during the war near Moccasin Slough had formed a dam across the river and forced a narrow and very crooked channel through its banks and into the river Styx.

The approved project for the improvement of the river contemplated securing a channel 100 feet wide and 6 feet deep, at low water, by the removal of snags and overhanging trees, and widening and straightening the channel at Moccasin Slough and the Elbows, at an estimated cost of $80,333.

In 1888 an examination was made of the Cut-off, Lee Slough, and the lower Chipola River, and the cost of opening a channel 60 feet wide and 5 feet deep through it was estimated at $7,500.

The act of September 19, 1890, appropriated $2,000 for the "Apalachicola River, including Lee's Slough," and the improvement of the latter is therefore added to the original project.

Up to June 30, 1890, the sum of $42,245.11 was expended on the original project. At this time the river was in a good navigable condition, except at Moccasin Slough and the Elbows, where further work is necessary to make navigation safe.

During the fiscal year ending June 30, 1891, the sum of $1,566.32 has been expended in the removal of snags, sunken logs, and overhanging trees from the Apalachicola River and from the Cut-off and lower Chipola River, which lead to Lee Slough.

No work has been done on Lee Slough proper for the reason that with the amount of money available it would have been impossible to accomplish any useful result. It was necessary that the snag-boat should clear a channel through the Cut off and lower Chipola River in order to reach Lee Slough. When this had been accomplished it was necessary for the snag-boat to return to the Chattahoochee and Flint rivers.

The small amount of work done on the Cut-off and lower Chipola River has enabled steamboats to reach the landings above and below Lee Slough and carry out the orange crop.

The country bordering on this slough is now attracting the attention of settlers, and would be rapidly developed if the Cut-off and Lee Slough and the lower Chipola River were so cleared of obstructions that the river steamboats would go through them on their regular trips.

The river affords the only practicable means of transportation for the products of this country.

The cost of opening Lee Slough is estimated at $7,500. The cost of improving Moccasin Slough and the Elbows is estimated at $5,000, and of the necessary snagging operations on the Apalachicola River, at $2,000.

July 1, 1890, balance unexpended	$320.79
Amount appropriated by act approved September 19, 1890	2,000.00
	2,320.79
June 30, 1891, amount expended during fiscal year	1,566.32
July 1, 1891, balance unexpended	754.47
July 1, 1891, outstanding liabilities	4.85
July 1, 1891, balance available	749.62
Amount that can be profitably expended in fiscal year ending June 30, 1893	14,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 2.)

3. *Flint River, Georgia.*—Before the improvement was begun the river was only navigable, at low water, from its mouth up to Bainbridge, and the channel over this portion was narrow, crooked, and much obstructed by logs, snags, and overhanging trees.

The present project for the improvement of this river was adopted in 1873 and modified in 1879, the object of the original project being to afford a channel 100 feet wide and 3 feet deep at low water, from its mouth up to Albany, Ga., an estimated distance of 105 miles; and of the modification, to provide a navigable channel for light-draft steamers, at moderate stages of water, from Albany to Montezuma, an estimated distance of 77 miles.

The expenditure up to June 30, 1890, of $136,203.77 has resulted in obtaining a navigable channel, having a low-water depth of 3 feet, and a width varying from 50 to 100 feet, from the mouth of the river nearly to Albany. Above Albany the river has been partially cleared of logs and snags, and, to a limited extent, of loose rock between Albany and Montezuma.

During the fiscal year ending June 30, 1891, $4,017.07 were expended in the care and preservation of plant, and in continuing work under the approved project.

Between the mouth of the river and Bainbridge, Ga., the river is now in a fair navigable condition, and only requires the annual clearing out of snags and logs brought in by the winter freshets.

Between Bainbridge and Albany, Ga., a channel having a low-water depth of 3 feet and a minimum width of 50 feet has been secured, but in many places this channel is too narrow and tortuous for safe navigation, and should be widened and straightened. The work will consist mainly in drilling and blasting and removing rock from the marl and rock shoals.

When completed the improvement will be comparatively permanent; but for the preservation of the improvement it will be necessary to maintain a snag-boat on the river, at an annual cost of about $5,000.

On account of the recent construction of a railroad through that section of country, the small steamer which formerly ran between Montezuma and Warwick, on the Upper Flint River, has been sold, and is now employed on the river below Albany. As far as known no com-

mercial use is now made of the river above Albany, and there are no indications that any such will be made in the near future.

It is therefore recommended that the requirement that "a certain portion of the appropriation for the Flint River shall be expended above Albany, Ga.," may be omitted from future appropriation acts for the present.

July 1, 1890, balance unexpended	$826.24
Amount appropriated by act approved September 19, 1890	20,000.00
	20,826.24
June 30, 1891, amount expended during fiscal year	4,017.07
July 1, 1891, balance unexpended	16,809.17
July 1, 1891, outstanding liabilities	2,042.48
July 1, 1891, balance available	14,766.69
Amount that can be profitably expended in fiscal year ending June 30, 1893	40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 3.)

4. *Chattahoochee River, Georgia and Alabama.*—The river was originally much obstructed by logs, snags, and overhanging trees, and by a number of rock and marl shoals and sand bars, so that navigation was difficult and dangerous. Steamboats could only run by daylight, and not unfrequently laid on sand bars for weeks at a time waiting for a rise in the river. Very many were lost by striking logs and snags.

The present plan of improvement adopted in 1873, and modified in 1882, contemplates a low-water channel 4 feet in depth and 100 feet in width from Columbus, Ga., to Chattahoochee, Fla., a distance of 224 miles, by the removal of snags and other obstructions from the channel and overhanging trees from the banks; by the excavation of rock shoals, and by works of contraction and shore protection.

Previous to the act of June 18, 1878, $70,000 was appropriated for the "Chattahoochee and Flint rivers," but the amounts apportioned to each river are not known.

Up to June 30, 1890, $170,832.91 of the appropriations for the Chattahoochee River alone had been expended, and with its share of the combined appropriations had resulted in securing a fair navigable channel between Chattahoochee, Fla., and Eufaula, Ala., at all seasons of the year, and between Eufaula, Ala., and Columbus, Ga., at all times, except during low water. Steamboats now make regular trips with but few accidents or detentions, running by night as well as by day. The limited annual appropriations for this improvement have not been sufficient to maintain the works of contraction constructed, nor to extend or modify them as required.

During the year ending June 30, 1891, $11,108.32 has been expended in maintaining the existing improvement, excavating rock shoals, and in repairing worn out plant.

The most serious obstructions to the navigation of this river are at the Mound and Woolfolk's Bar, between Eufaula and Columbus. At both of these places the banks are caving badly, and the navigation is yearly becoming more difficult and dangerous. At low stages, boats have to be warped over the bars. There is also trouble at Francis Bend, above Eufaula, and at Kings Rock, about 200 miles below Columbus.

If sufficiently large appropriations were made to permanently improve these localities it is believed that thereafter the navigation of the

river could be maintained in good condition throughout the year by annual appropriations of $10,000, for the repair and maintenance of the work and for the removal of the annual accumulation of logs and snags brought in by the winter freshets.

On account of high water it has not been practicable to make a detailed examination and estimate of the cost of improving these localities, but it is known that at least $75,000 can be profitably expended in this work during the fiscal year ending June 30, 1893.

July 1, 1890, balance unexpended	$2,185.30
Amount appropriated by act approved September 19, 1890	20,000.00
	22,185.30
June 30, 1891, amount expended during fiscal year	11,108.32
July 1, 1891, balance unexpended	11,076.98
July 1, 1891, outstanding liabilities	526.71
July 1, 1891, balance available	10,550.27
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	75,000.00

(See Appendix P 4.)

5. *La Grange Bayou and Holmes River, Florida.*—La Grange Bayou is situated on the north side and near the head of Choctawhatchee Bay, and into it flows Cedar Creek, a deep stream from 90 to 160 feet, on which is situated the town of Freeport, 1½ miles above the bayou.

The channel through the bayou was originally narrow and shoal, and obstructed by logs and drift.

An examination of the bayou was made in 1881, under the act of Congress approved March 3, 1881, and an estimate submitted for dredging the channel so as to admit the passage of vessels drawing 4½ feet at mean low water, at a cost of $19,994.30.

In 1883 the sum of $2,000, allotted from the appropriation of $20,000, made by the act of August 2, 1882, for the improvement of Choctawhatchee River, Florida, was expended, mainly in removing snags and drift, and in dredging a small amount of mud from the shoalest part of the channel. Since then no work has been done.

The act of August 5, 1886, appropriated $2,000 for this improvement. It was decided that so small a sum could be more profitably expended by holding it until an additional appropriation was made.

The act of August 11, 1888, appropriated $3,000, for *completing* the improvement of La Grange Bayou, including Holmes River, up to the town of Vernon.

An examination and partial survey, made in 1889, showed that the amount of $5,000, then available for the improvement, was not sufficient to complete it as required by the act, and the Secretary of War therefore directed that no further expenditures should be made.

Before the completion of the Pensacola and Atlantic Railroad the town of Freeport was the center of trade for a large section of country surrounding it. This trade was mainly carried on in vessels plying between Pensacola and Freeport.

Since the completion of the railroad, however, the commerce of Freeport and La Grange Bayou has diminished to such an extent that in 1889 there was only one store in Freeport, and but one schooner made occasional trips between that point and Pensacola.

No necessity now appears to exist for the further improvement of La Grange Bayou, Florida.

Holmes River is an affluent of the Choctawhatchee River. It is a wide and deep stream, but was much obstructed by snags, logs, and overhanging trees. No work was done on it until last winter.

During the fiscal year ending June 30, 1891, the sum of $3,000 was expended in removing these obstructions. For this purpose the log-boat belonging to the Choctawhatchee River was used.

The river is now in good navigable condition, but there is very little trade carried on. The improvement made will probably render the navigation of the river safe for several years to come, and no further appropriation is therefore recommended at present.

July 1, 1890, balance unexpended	$4,839.20
Amount appropriated by act approved September 19, 1890	3,000.00
	7,839.20
June 30, 1891, amount expended during fiscal year	3,000.00
July 1, 1891, balance unexpended	4,839.20

(See Appendix P 5.)

6. *Choctawhatchee River, Florida and Alabama.*—When work on the improvement was first commenced in 1874, the river, although having an average width of 300 feet, was almost totally obstructed, only admitting narrow barges and flats of light draft to be navigated, and the channel—if a channel existed at all—was such as to be exceedingly dangerous to navigation, particularly during low-water stages.

The project for improvement adopted in 1880 contemplated the improvement of the river to obtain a low-water navigable channel from its mouth to Geneva, Ala., an estimated distance of 125 miles, and a navigable high-water channel from Geneva to Newton, Ala., an estimated distance of 37 miles.

In accordance with the act of August 11, 1888, an examination and partial survey were made for the purpose of estimating the cost of providing low-water navigation from Geneva to Newton. The cost of this improvement was estimated at $57,125.

The act of September 19, 1890, provided for continuing the improvement under the existing projects, and to secure low-water navigation between Geneva and Newton, "provided that no part of the money appropriated should be expended above Hollis Bridge until a draw approved by the Secretary of War was put in said bridge." The present project therefore provides for obtaining a low-water navigable channel from its mouth to Newton, Ala., an estimated distance of 162 miles, by removing logs and snags from the channel and overhanging trees from the banks, and by excavating sand bars, and by works of contraction and shore protection.

The expenditure up to June 30, 1890, of $96,126.23 has resulted in giving a fairly navigable channel, except at extreme low water, from the crossing of the Pensacola and Atlantic Railroad at Caryville, Fla., to Geneva, Ala., a distance of 25 miles, and a partially improved channel from Geneva to Pates Landing, a distance of 25 miles. As a consequence steamboats now run with considerable regularity between Geneva, Ala., and Caryville, Fla., and the population of the country is increasing rapidly. The river is the only outlet for their products, and its improvement is therefore of the greatest importance to the development of this region.

During the year ending June 30, 1891, $1,303.37 has been expended in the care and preservation of plant, and in snagging operations between Geneva and Caryville.

The Alabama Midland Railroad, recently completed from Montgomery, Ala., to Bainbridge, Ga., passes through Newton, Ala., and it is doubtful if that portion of the river between Geneva and Newton would now be much used even if the improvement were completed.

On account of the great importance of that portion of the river between Geneva and Caryville, the greater part of the funds now available will be expended during the coming year in work upon it, although, if practicable, the snag-boat will proceed as far as Pates Landing. On account of the changes which have taken place since the estimate submitted in 1880, it is not now possible to submit an accurate estimate of the cost of completing the existing project. The ultimate cost will be very much reduced if sufficiently large appropriations were made to enable works of contraction and shore protection to be built where needed. This has not hitherto been practicable, and the work has been confined almost entirely to snagging operations.

July 1, 1890, balance unexpended	$873.77
Amount appropriated by act approved September 19, 1890	12,500.00
	13,373.77
June 30, 1891, amount expended during fiscal year	1,303.37
July 1, 1891, balance unexpended	12,070.40
July 1, 1891, outstanding liabilities	1,440.01
July 1, 1891, balance available	10,630.39
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	30,000.00

(See Appendix P 6.)

7. *Harbor at Pensacola, Florida.*—In 1878 the channel was much obstructed by wrecks, and a survey made in 1879 showed that the inner bar had shoaled to a depth of 19 feet at mean low water. This depth was not sufficient to accommodate a large number of vessels seeking entrance to the port. The western shore of the entrance to the harbor, which is the site of old Fort McRee was fast washing away, and a large portion of the fort had disappeared. Corresponding changes in the directions of the channel and of the tidal currents had occurred, and to this was partly attributed the shoaling of the inner bar. The removal of the wrecks was began in 1878.

The plan of improvement adopted in 1881, in accordance with the report of the Board of Engineers, contemplates dredging a channel 300 feet wide and 24 feet deep at mean low water across the inner bar, for the temporary relief of the navigation of the harbor, and protecting the shore line near Fort McRee from further abrasion by the construction of jetties and works of shore protection, with a view to retaining this position for defensive purposes, and preventing further injurious changes in the tidal currents.

The expenditure up to June 30, 1890, of $241,844.89 has resulted in obtaining, temporarily, a channel across the inner bar reported to be 120 feet wide and 24 feet deep, at mean low water, at the conclusion of dredging operations in 1886. Since then no dredging has been done and the channel has gradually shoaled until it now has a least depth of 19 feet at mean low water.

Between 1881 and 1887, the further abrasion of the western shore line, near Fort McRee, was stopped by the construction of two jetties north of the fort, and nearly at right angles to the shore, having lengths, respectively, of 360 and 220 feet. The jetties were originally of a ten-

tative character, and were built of two parallel rows of close piling, filled with alternate layers of brush and stone, with side slopes of similar construction. They were exposed to the attacks of the teredo and to the destructive action of severe storms.

Previous to 1888, notwithstanding that much repair and auxiliary work had been done to preserve them, not more than 25 per cent. of the jetties remained. Their usefulness in preserving the shore line having been demonstrated, it was then decided to rebuild them in a substantial manner by covering them with a coping and side slopes of heavy stone and concrete blocks.

This work was completed in April, 1890, and, although this coast has been visited by unusually heavy storms since then, the reconstructed jetties have stood perfectly, without settlement or derangement.

During the year ending June 30, 1891, $7,585.15 has been expended in the care and preservation of the property belonging to the improvement; in testing cements used in the construction of the jetties; in completing the survey of the entrance to the harbor, and in making a relief map thereof; in defraying the expenses of the Board of Engineers on the further improvement of the harbor, and in obtaining the data required by the Board.

On January 7, 1891, the officer in charge submitted his report of the survey of the previous summer. The subject of the further improvement of the harbor was then referred to a Board of Engineers, and its report is printed in Appendix P 7.

In June, 1891, the continued shoaling of the inner bar was causing such serious detriment to the commercial interests of the port, many loaded vessels being unable to leave the harbor, that the hiring of the suction dredge *Bayley* from the Mississippi River Jetty Company was authorized.

This dredge commenced work on June 29, 1891, and it is expected, with the favorable weather to be expected at this season of the year, that a channel across the inner bar 150 feet wide and sufficiently deep to admit the passage of vessels drawing 23 feet of water will be completed within 45 days with the available funds.

July 1, 1890, balance unexpended		$8,155.11
Amount appropriated by act approved September 19, 1890		25,000.00
		33,155.11
June 30, 1891, amount expended during fiscal year		7,585.15
July 1, 1891, balance unexpended		25,569.96
July 1, 1891, outstanding liabilities	$345.21	
July 1, 1891, amount covered by uncompleted contracts	18,000.00	
		18,345.21
July 1, 1891, balance available		7,224.75

Amount that can be profitably expended in fiscal year ending June 30, 1893 500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 7.)

8. *Escambia and Conecuh rivers, Florida and Alabama.*—These rivers are really one river; that portion of the river from its headwaters in South Alabama to the Florida and Alabama State line being called the Conecuh River, and the portion in Florida being called the Escambia River. It empties into the Escambia Bay, which is itself an indentation from Pensacola Bay. Fully 50 per cent. of the immense quantity of timber shipped from Pensacola Harbor is cut on lands tributary to this river, and floated down in rafts to Pensacola Harbor.

The river originally was much obstructed by snags, sunken logs, and rock shoals, and by a very shoal bar at the mouth. Steamboat navigation was not attempted, and rafts had much difficulty in passing down the river.

The plan of improvement for this river, adopted pursuant to examinations and surveys made in 1878 and 1879, contemplates the removal of snags, sunken logs, and other obstructions from the channel, cutting through rock shoals and deepening sand-bars, by works of contraction and shore protection, from the mouth of the river, in Pensacola Bay, to the mouth of Indian Creek, an estimated distance of 293 miles, for the purpose of facilitating the movement of timber down the river, affording at the same time facilities for steamboat navigation.

The amount expended to June 30, 1890, $57,230.92, has resulted in twice dredging the channel through the bar at the mouth of the river, and the removal of obstructions to navigation, so that at that time the river was navigable at ordinary stages, for steamboats drawing 5½ feet of water, from Ferry Pass to Skinners Landing, a distance of 17 miles; and for boats drawing 3 feet to the Alabama State line, and the river had been so far cleared of logs, snags, and overhanging trees that the lower 133 miles was in a fair navigable condition for all stages of water higher than 2½ feet above low water.

During the fiscal year ending June 30, 1891, $2,370.83 was expended upon this improvement, but on account of the late passage of the river and harbor act, no work other than repairs to the plant was undertaken until May, 1891; since which time the log boat has been employed in pulling snags and cutting overhanging trees from Molino up-stream.

It is not probable that for some time, at least, this river will be much used by steamboats for commercial purposes, but the most extensive timber lands of South Alabama and Florida are tributary to it, and millions of feet of lumber are annually rafted down it for export from Pensacola Harbor.

In order that this business may be carried on safely and profitably, the river should be kept free from snags and like obstructions by an efficient snag-boat, and the bar at the mouth of the river should be dredged in order that the large tugs employed in Pensacola Harbor may ascend to Ferry Pass for the purpose of towing out rafts.

To keep the river free from obstructions the snag-boat should be provided with its own motive power, the cost of which is estimated at $3,000.

The cost of dredging the bar at the mouth of the river to a depth of 8 feet at mean low water is estimated at $12,000.

The annual cost of operating the snag-boat is estimated at $5,000, or $10,000 for 2 years.

July 1, 1890, balance unexpended		$1,914.38
Amount appropriated by act approved September 19, 1890		7,500.00
		9,414.33
June 30, 1891, amount expended during fiscal year		2,361.88
July 1, 1891, balance unexpended		7,052.55
July 1, 1891, outstanding liabilities		653.84
July 1, 1891, balance available		6,398.71
Amount that can be profitably expended in fiscal year ending June 30, 1893		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 8.)

9. *Alabama River, Alabama.*—Before improvements were begun in 1878, the river was so full of sunken logs and snags, and so obstructed

by bars, shoals, and reefs—on many of which the low-water depth was only 2½ to 3½ feet—that navigation was both difficult and dangerous, and many boats were destroyed. At low-water stages boats could only run by daylight, and long detentions at the bars and shoals were frequent. The normal width of the upper river is from 500 to 600 feet, and of the lower river from 700 to 800 feet. In the portions of the river having these widths the low-water depths vary from 8 to 15 feet; but where the river has been widened by the erosion of its banks, bars, shoals, and reefs are found. That portion below the Cut-off—20 miles in length—was absolutely inaccessible during low water, and all landings situated thereupon were deprived of steamboat service during that season.

The plan of improvement adopted, pursuant to an examination and partial survey of this river, made under act of Congress approved March 3, 1875, provided for obtaining a channel 200 feet in width and 4 feet in depth, at low water, from the mouth of the river, 44 miles above Mobile, to Wetumpka, Ala., a distance of 323 miles, by the removal of snags, logs, etc., from the channel; cutting overhanging trees from the banks; removing rock and gravel reefs by blasting and dredging; and deepening sand bars by works of contraction and shore protection.

The expenditure of $160,402.05 up to June 30, 1890, has resulted in clearing the river of dangerous snags and overhanging timber; in the improvement of eight of the worst bars, by works of contraction, which, however, are now in bad condition, and need extensive repair; in opening the 20 miles of the river below the Cut-off; in an increased safety to navigation; greater regularity and reduction in time of trips, and enabling boats to carry larger loads.

Boats now run by night as well as by day at all stages of water.

During the year ending June 30, 1891, $7,042.17 were expended in maintaining the existing improvement.

The act of September 19, 1890, required an examination of the Alabama River, Alabama, to ascertain the cost of securing a 6-foot channel at low water from the mouth to Wetumpka, Ala. The report of the officer in charge was submitted on December 10, 1890, and is published in House Ex. Doc. No. 140, Fifty-first Congress, second session. (See Appendix P 15.)

For the reasons that the present large and growing commerce of the Alabama River will be greatly benefited by having a 6 foot channel, and that this river, with its tributaries, forms a natural route for the transportation to the Gulf of Mexico of the coal and iron products of a vast territory, and that a 6-foot channel will be required for the profitable development of this traffic, the officer in charge considered the river worthy of improvement as proposed, and estimated the cost of securing a 6-foot channel at $386,251, and the annual cost of maintaining the same at $10,000. The views of the officer in charge were concurred in by the Division Engineer.

It is estimated that $100,000 can be profitably expended during the fiscal year ending June 30, 1893.

July 1, 1890, balance unexpended	$4,597.95
Amount appropriated by act approved September 19, 1890	20,000.00
	24,597.95
June 30, 1891, amount expended during fiscal year	7,042.17
July 1, 1891, balance unexpended	17,555.78
July 1, 1891, outstanding liabilities	1,154.05
July 1, 1891, balance available	16,401.73

Amount that can be profitably expended in fiscal year ending June 30, 1893 $100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 9.)

10. *Tallapoosa River, Alabama.*—The condition of the river, when first examined in 1881, was such that, at low water, navigation was entirely impracticable on account of the numerous sand and gravel bars and reefs of rock across the river, and the great accumulation of logs and snags in the channel. The latter also rendered high-water navigation difficult and dangerous. But for these obstructions the river presented, generally, long reaches of fine navigable water, with a width of 200 to 300 feet, and a depth of 6 to 12 feet, but where this depth was exceeded to any extent, gravel and sand bars were found, with a low-water depth of only 1 to 2 feet.

The original project, adopted pursuant to an examination and partial survey made in 1881, provided for obtaining a navigable channel from the junction with the Coosa River, where the two rivers form the Alabama River, to the foot of Tallassee Reefs, 2 miles below the town of Tallassee, a distance of 48 miles, with a least depth of 3 feet and width of 200 feet in open river, and 60 feet through the soft rock reefs, by the removal of snags and logs from the channel and overhanging trees from the banks, by cutting through the gravel and rock reefs, and by deepening the sand bars by works of contraction and shore protection.

The expenditure of $39,666.58 up to June 30, 1890, had resulted in providing a suitable snag boat, in removing snags and logs obstructing the channel, in cutting down dangerous overhanging timber, in building 320 feet of temporary jetty between the mouth and Cowles Ferry, an estimated distance of 43 miles, and in reworking each year the part passed over during the previous season, and removing snags and logs brought down by freshets. That portion of the river under improvement is now navigable at moderate stages of water.

It is proposed to expend the balance now available during the summer of 1891 in blasting a channel through "Sunken," "Zimmerman," and "Goodwin" reefs, which will result in providing a low-water channel, having a depth of 3 feet from the mouth to Cowles Ferry. From Cowles Ferry to the foot of Tallassee Reefs, a distance of 5 miles, the river is much obstructed by logs and snags and overhanging timber, the cost of removing which is estimated at $5,000.

On account of the late date on which the appropriation of September 19, 1890, became available, and the prevalence of high water during the following winter and spring, no work was done during the past fiscal year, except the repair and care of the working plant, at a cost of $832.70.

The original estimate of the cost of the improvement was $40,125, but this contemplated continuous and expeditious work, with sufficient appropriations. These, however, have not been provided, and the greater part of the money heretofore appropriated has been expended in the removal of the annual accumulation of logs and snags, and but a small amount has been available for the more permanent work contemplated by the project. On account of changes which have since occurred the survey of 1881 does not now furnish the data necessary for estimating the amount required to complete the existing project.

July 1, 1890, balance unexpended	$351.42
Amount appropriated by act approved September 19, 1890	4,000.00
	4,351.42
June 30, 1891, amount expended during fiscal year	832.70
July 1, 1891, balance unexpended	3,518.72
July 1, 1891, outstanding liabilities	44.32
July 1, 1891, balance available	3,474.40
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 10.)

11. *Coosa River, Georgia and Alabama.*—The river was originally much obstructed by rock shoals and sand bars between Rome, Ga., and Greensport, Ala., and below Greensport it was not navigable at all on account of the many shoals and rapids formed by ledges of rock crossing the river bottom at points where the width of the river was greater than the normal. The normal width of the river at low water is from 500 to 800 feet. From Rome, Ga., to Greensport, Ala., an estimated distance of 162 miles, the river has an average slope of about 5 inches per mile, with banks which are firm and not easily eroded. From Greensport down to Wetumpka, Ala., an estimated distance of 142 miles, the profile of the natural river at low water exhibits a succession of deep pools, varying in length from one-half to 8 miles, separated by shoals formed of ledges of solid rock or loose stones and detached bowlders which frequently rise above the surface. The shoals extend along the river for distances varying from a few feet to 12 miles, and have depths of water varying from a few inches to several feet. Velocity observations at Wetumpka showed a low-water discharge of 5,796 cubic feet, about the same as that reported for the Mississippi River at St. Paul. The abundance of water, the stability of the banks and bottom of the river, and the rock foundations for locks and dams, presented in all cases, make the lower portion of the river peculiarly susceptible of permanent improvement by a system of slackwater navigation.

By means of the Upper Coosa, the Oostenaula, and Coosawattee rivers there is now a stretch of 293 miles of navigable river above Lock No. 4, and by means of the Coosa and Alabama rivers a stretch of 367 miles of easily navigable river below Wetumpka. The improvement of the 116 miles of river between Lock No. 4 and Wetumpka will therefore afford a continuous route of water transportation, 776 miles in length, from Northwestern Georgia, through the mineral region of North Alabama, to the Gulf of Mexico at Mobile, Ala.

Pursuant to various examinations and surveys made between 1870 and 1878, a plan of improvement was originally adopted which contemplated the removal of the lesser rock shoals and sand and gravel, by excavation and by works of contraction, so as to give a minimum depth of 3 feet at low water in the channel; and the construction of locks and dams to overcome the more serious obstructions below Greensport. The project as approved was limited to the section of river between Rome, Ga., and the East Tennessee, Virginia and Georgia Railroad Bridge, an estimated distance of 236 miles.

Under the act of August 11, 1888, a survey was made between May and November, 1889, from the rapids at Wetumpka to connect with the improvements already completed below Greensport. The report of this survey, submitting a plan and estimates for the improvement of this

portion of the river, was printed in House Ex. Doc. No. 94, Fifty-first Congress, first session, and in the Annual Report of the Chief of Engineers for 1890, page 1665.

a. Between Rome, Georgia, and the East Tennessee, Virginia and Georgia Railroad Bridge.—The expenditure up to June 30, 1890, of $519,671.31 had resulted in securing a fairly navigable channel from Rome, Ga., to Greensport, Ala., by blasting out the rock shoals, and by the construction of wing dams to scour out the sand bars. Three masonry locks, each 40 feet wide by 210 feet between miter sills, at distances, respectively, of 0.68, 3.86, and 5.24 miles below Greensport, with their accessory dams and dikes, were sufficiently completed to be opened to navigation in the spring of 1890, and the Rome and Gadsden steamers now extend their trips to landings below Lock No. 3.

During the year ending June 30, 1891, the sum of $63,713.61 has been expended. Lockkeepers' houses have been built at Locks Nos. 1, 2, 3, and 4. At Lock No. 1 guide cribs have been built at the head and foot of the lock; two levees have been built, and such portions of the land side of the lock as were subject to wash in high water have been paved.

At Lock No. 2 a guide crib has been built at the foot of the lock, and such portions of the bank on the land side of the lock as were subject to wash at high water have been paved.

At Lock No. 3 a guide pier has been built at the head of the lock, and a similar pier at the foot of the lock partly built; the bank on the land side of the lock has been leveed and paved, where subject to wash, and the dam has been strengthened. Some channel work has been done below the lock.

At Lock No. 4 material has been procured for building the permanent dam and the cofferdam; a new quarry has been opened, and part of the stone needed for the abutment and for filling the dam has been quarried; a tram-road, leading from the lock to this quarry, a distance of 1.9 miles, has been built and equipped with small locomotive and cars; and a hoisting and conveying apparatus has been procured for conveying the stone from the end of the tramway to the dam and the abutment on the opposite side of the river by means of a wire cable stretched across the river over the site of the dam. Other necessary plant, in the way of hoisting engines, steam pumps, etc., has been bought. It is expected with the money now available to be able to complete, during the present season, the dam, abutment, and levee, and the upper part of the cofferdam.

b. Between Wetumpka and the East Tennessee, Virginia and Georgia Railroad Bridge.—The act of September 19, 1890, appropriated $150,000 for the improvement of this portion of the river, with the proviso that such improvement "be made in harmony with the existing approved project for the improvement of the Coosa River between Rome and said bridge; locks to be 40 feet wide and 210 feet between miter sills."

During the year ending June 30, 1891, $8,681.34 has been expended.

In order to determine the best location for Lock No. 31 at Wetumpka, and for Locks Nos. 30 and 29, at approximate distances, respectively, of 2 miles and 4.65 miles above Wetumpka, it was necessary to make a careful and detailed survey of this portion of the river, and to take careful velocity and discharge measurements at all stages of the river from low to high water. For this purpose a surveying party has been employed at Wetumpka since October, 1890.

The proposed location of Lock No. 31 is now under consideration. As soon as this is definitely decided upon the available balance will be

used in the purchase of the necessary land; in opening the required channel through the rock ledge above the site of the lock; in procuring the necessary plant and materials; in the erection of lock-keeper's dwelling, to be used as an office during construction; and in procuring by contract, if practicable, so much of the stone needed for the construction of the lock as may be possible with the funds available.

The act of September 19, 1890, prescribes that the size of the locks to be built on the Coosa River shall be 40 feet wide by 210 feet between miter sills, which will give an available length of about 175 feet.

The main object of this improvement is to provide cheap transportation for the coal and iron deposits of the Coosa Valley to the Gulf of Mexico. The coal and iron ore will be carried in barges towed by steamboats. The size of lock prescribed will only admit the entrance, at one time, of one towboat or one barge. It will therefore be necessary to break up every tow at each of the twenty-eight locks to be built below the Broken Arrow coal fields and lock each towboat and barge separately. This operation will involve so much loss of time and such additional expense that it is doubtful if the traffic can be carried on profitably.

On no other river whose improvement by locks and dams has been undertaken by the Government has a size of lock less than 52 feet wide by 322 between miter sills, giving an available length of 280 feet, been adopted. A lock of this size admits the passage through the lock, at one time, of one towboat, 150 by 25 feet, and of three standard coal barges, each 130 by 25 feet. This size of locks has been adopted for the Black Warrior and Cumberland rivers. The new locks on the Great Kanawha are larger.

It is urgently recommended that in the next appropriation bill the present restriction as to the size of the locks to be built on the Coosa River may be repealed. This will require no sacrifice of work already done, as no actual construction work either on Lock No. 4 or Lock No. 31 will be done until a new appropriation is available.

The estimated cost of a masonry lock 40 feet wide by 210 feet between miter sills, with a lift of 11 feet, which is the average lift of all the locks to be built on the Coosa River, is in round numbers $130,000; and of a similar lock 52 feet wide by 322 feet between miter sills is $170,000.

The subjoined estimates of cost of completing the existing projects provide for locks 40 feet by 210 feet, and for dams, abutments, and levees of the design recently approved for Lock No. 4.

Between Rome, Georgia, and East Tennessee, Virginia and Georgia Railroad Bridge.

July 1, 1890, balance unexpended	$4,028.69
Amount appropriated by act approved September 19, 1890	150,000.00
	154,028.69
June 30, 1891, amount expended during fiscal year	63,713.61
July 1, 1891, balance unexpended	90,315.08
July 1, 1891, outstanding liabilities	22,294.11
July 1, 1891, balance available	68,020.97
Amount (estimated) required for completion of existing project	1,090,133.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Between Wetumpka and the East Tennessee, Virginia and Georgia Railroad Bridge.

Amount appropriated by act approved September 19, 1890	$150,000.00
June 30, 1891, amount expended during fiscal year	8,681.34
July 1, 1891, balance unexpended	141,318.66
July 1, 1891, outstanding liabilities	823.45
July 1, 1891, balance available	140,495.21
Amount (estimated) required for completion of existing project	4,943,074.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P 11.)

12. *Operating and care of canals and other works of navigation on Coosa River, Georgia and Alabama.*—The expenses of operating Locks Nos. 1, 2, and 3 during the past fiscal year have been paid in the manner indicated by section 4, act of July 5, 1884.

The amount expended during the fiscal year ending June 30, 1891, was $2,530.67.

(See Appendix P 12.)

13. *Cahaba River, Alabama.*—The report of the examination of this river from its mouth to Centreville, Ala., in 1874, states that—

> On thirteen of the shoals there is only 1 foot of water, and on two as little as eight-tenths of a foot. Besides this there are innumerable snags, the accumulation of years, and also a great quantity of leaning trees, which must be removed owing to the narrowness of the stream even at a stage several feet above low water. * * * The river is spanned by three bridges. * * * * The railroad bridges are only a few inches above high water, while the road bridge is sometimes submerged.

The road bridge mentioned was carried away by the flood of 1881.

Under acts of Congress approved June 23, 1874, and June 17, 1880, examinations and partial surveys were made in 1874 and in 1880, and a plan of improvement was adopted which provides for obtaining for the lower Cahaba River, from its mouth to the town of Centreville, a distance of 88 miles, a navigable channel with a width in open river of 100 feet, and in soft rock and bar cuts of 60 feet, having a depth at low water of 3 feet, by the removal of snags, etc., from the channel and overhanging trees from the banks, by cutting through the soft rock and gravel bars, and by contracting and regulating the channel.

The expenditure up to June 30, 1886, of $28,989.79 had resulted in the partial improvement of the river from its mouth to Centreville, adapting it to high-water navigation; but, on account of the obstructing railroad bridges, steamboats were unable to make any use of the improved river. Since that time no work has been done, because of a proviso in the river and harbor act of August 5, 1886, that—

> No part of said sum [$7,500 appropriated for this work] shall be expended until the officer in charge shall have reported that the railroad and other bridges across said river have been provided with good and sufficient draw openings.

These bridges continue to obstruct the navigation of the river, not having been provided with draw openings.

The act of September 19, 1890, provided that—

> The existing provision restricting the expenditure of the balance now available for the improvement of said river are hereby repealed, and said balance shall be expended in continuing the improvement thereof.

Under this appropriation an examination of the river was made in November, 1890; the construction of a light-draft log boat, to be used in working on the river, was authorized, and was begun in April.

This boat will be finished in July, 1891, and will be put to work clearing the river of logs and snags until the available funds are exhausted.

During the fiscal year ending June 30, 1891, $3,506.56 were expended in defraying the expenses of the examination and in the construction of the log boat and the purchase of the necessary machinery for it.

July 1, 1890, balance unexpended	$7,770.35
June 30, 1891, amount expended during fiscal year	3,506.56
July 1, 1891, balance unexpended	4,263.79
July 1, 1891, outstanding liabilities	2,004.29
July 1, 1891, balance available	2,259.50
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	20,000.00

(See Appendix P 13.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Chattahoochee River, Georgia and Alabama, between West Point and Franklin*, was made by the local engineer in charge, Captain Price, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Price, based upon the facts and reasons given, that this locality is worthy of improvement; but Colonel Comstock, in view of the cost of improvement and the present and prospective wants of commerce, does not consider the locality worthy of improvement at this time. The views of Colonel Comstock being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 134, Fifty-first Congress, second session. (See also Appendix P 14.)

The required preliminary examination of *Alabama River, Alabama, to ascertain cost of securing a 6-foot channel at low water from mouth to Wetumpka*, was made by the local engineer in charge, Captain Price, and report thereon submitted though Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Price, and of the Division Engineer, based upon the facts and reasons given, that this river is worthy of improvement as proposed. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The cost of securing a 6-foot channel as proposed is estimated at $386,251, and the annual cost of maintaining it at $10,000. The report was transmitted to Congress and printed as House Ex. Doc. No. 140, Fifty-first Congress, second session. (See also Appendix P 15.)

IMPROVEMENT OF CERTAIN RIVERS IN ALABAMA AND MISSISSIPPI, OF BOGUE CHITTO, LOUISIANA, AND OF HARBORS AT MOBILE, ALABAMA, AND BILOXI, MISSISSIPPI.

Officer in charge, Maj. A. N. Damrell, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Mobile Harbor, Alabama.*—The present project for the improvement of this harbor was adopted in August, 1888, the object being to afford a channel of entrance from the Gulf of Mexico to the city of

Mobile of 280 feet width on top of cut, with a central depth of 23 feet at mean low water by dredging, at an estimated cost of $1,980,000. Length of continuous cut, 29¾ miles. Act of September 19, 1890, extended the work up Mobile River to the mouth of Chickasabogue Creek and increased the estimated cost to $2,043,800. The channel had originally a minimum depth of 5½ feet through Choctaw Pass and 8 feet on Dog River Bar. This was deepened by dredging under appropriations from 1826 to 1852 of $228,830.68 to 10 feet through both.

In 1860 the channel in Choctaw Pass had shoaled to 7½ feet.

From 1870 to 1878 the channel was deepened by dredging to 13 feet under appropriations amounting to $401,000. Length of cut 8 miles. From 1881 to 1888 the channel was deepened by dredging to 17 feet, under appropriations amounting to $740,000, but this project was not completed when the last project was adopted. The length of cut was 25.91 miles.

The entire length of channel under present project is 31.85 miles and the entire length of continuous cut is 29.98 miles.

Since the adoption of the last, or present, project a channel has been dredged to a depth of 19 feet and width of 80 feet from where there was that depth in Mobile River to where the same depth was found in the lower part of the bay, a continuous cut of over 26 miles; about one-half was done in the fiscal year 1888–'89, and the remainder during the fiscal year 1889–'90.

The lower portion has shoaled so that the least depth is now 14.7 feet.

The average central depth is, however, about 19.4 feet for the whole length of the channel.

The amount available is to be applied to continuing the improvement in accordance with the approved project, and it is believed will secure a minimum depth of at least 20 feet.

July 1,1890, balance unexpended		$2,508.25
Amount appropriated by act approved September 19, 1890		350,000.00
		352,508.25
June 30, 1891, amount expended during fiscal year		59,188.57
July 1, 1891, balance unexpended		293,319.68
July 1, 1891, outstanding liabilities	$27,829.30	
July 1, 1891, amount covered by uncompleted contracts	244,889.32	
		272,718.62
July 1, 1891, balance available		20,601.06

Amount (estimated) required for completion of existing project	1,443,800.00
Amount (estimated) required for preservation of improvement	60,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,503,800.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 1.)

2. *Warrior and Tombigbee rivers, Alabama and Mississippi.—a. Warrior River, Alabama.*—The present project for the improvement of this river was adopted in 1890 the object being to obtain a channel 6 feet deep at ordinary low water from Tuscaloosa to its mouth by removal of logs, snags, and overhanging trees, the improvement of bars, bank revetment, and the construction of locks and dams, at an estimated cost of $577,000. The channel at this time is not navigable at a low-water stage.

The amount expended during the fiscal year ending June 30, 1891,

was $21,840.85 and was used in construction of a portion of plant required for prosecution of the work.

The amount available is to be expended in removal of snags, logs, and overhanging trees and repairs of jetties.

July 1, 1890, balance unexpended	$13,967.98
Amount appropriated by act approved September 19, 1890	45,000.00
	58,967.98
June 30, 1891, amount expended during fiscal year	21,840.85
July 1, 1891, balance unexpended	37,127.13

Amount (estimated) required for completion of existing project	532,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

b. Tombigbee River, Mississippi, from Walker Bridge to Fulton.—The present project for the improvement of this section of the river was adopted in 1888, the object being to obtain a good channel for navigation during high water by the removal of snags, logs, stumps, and cutting overhanging trees, at an estimated cost of $11,000.

The channel was originally only navigable for small rafts, and very troublesome for them. The amount expended to June 30, 1890, was $3,734.70 and resulted in improving about one-half of the entire distance according to the project.

The amount expended during the fiscal year ending June 30, 1891, is $2,782.48, and resulted in completion of the project.

July 1, 1890, balance unexpended	$265.30
Amount appropriated by act approved September 19, 1890	4,000.00
	4,265.30
June 30, 1891, amount expended during fiscal year	2,782,48
July 1, 1891, balance unexpended	1,482.82

Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

c. Tombigbee River, from Fulton, Mississippi, to Vienna, Alabama.—The project for the improvement of the river from Fulton down to Columbus, 144 miles, was adopted in 1873, the object being to give a good high-water navigation throughout by the removal of snags and overhanging trees.

The channel before improvement was not navigable at all from Fulton down to Cotton Gin Port, 69½ miles. From Cotton Gin Port down to Aberdeen, about 25 miles, it was navigable for small barges carrying about 125 bales of cotton. From Aberdeen down to Columbus, about 49½ miles, navigation was difficult when the river was 12 feet above ordinary low water.

The project for the improvement of the portion of the river between Columbus and Vienna was adopted in 1879, the object being to afford a channel of navigable width and 3 feet deep during ordinary low water.

Before the improvement was commenced the channel was much obstructed by snags and overhanging trees, and there was only 1 foot of water on some of the bars during low water.

The amount expended to June 30, 1890, was about $82,074.57 (exact figures can not be given for reasons that appropriations were made

jointly for Warrior and Tombigbee rivers) and resulted in the completion of the proposed improvement of that section of the river from Fulton down to Columbus, and in giving such a channel from Columbus down to Vienna that navigation was possible on a 2-foot rise for boats drawing 3 feet, and the accomplishment of over one-half the work.

The amount of $5,261.23 has been expended during the fiscal year ending June 30, 1891, in preparation of a portion of the plant required for future work and the commencement of work at three different points on this section of the river. This section of the river should be designated hereafter as Fulton to Columbus, the portion below Columbus being incorporated by the act of September 19, 1890, with that designated as "Tombigbee River from Demopolis to Columbus, Mississippi."

July 1, 1890, balance unexpended	$3,975.49
Amount appropriated by act approved September 19, 1890	6,000.00
	9,975.49
June 30, 1891, amount expended during fiscal year	5,261.23
July 1, 1891, balance unexpended	4,714.26
Amount (estimated) required for preservation of improvement	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	8,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

d. Tombigbee River, Alabama, below Vienna.—The project for the improvement of this portion of the river was adopted in 1879, the object being to afford a channel of navigable width and 4 feet deep at ordinary low water from the mouth up to Demopolis, and 3 feet deep from Demopolis up to Vienna. Before the improvement the river was navigable from the mouth up to Bladon Springs, 91 miles, during the entire year; from Bladon Springs up to Demopolis, 100 miles, navigation was suspended about 2 months yearly during low water.

From Demopolis up to Vienna the channel was obstructed by snags and overhanging trees, and water was so shoal on the bars that navigation was only attempted on a considerable rise.

The amount expended to June 30, 1890, was about $112,292.21 (exact figures can not be given, as appropriations were made jointly for Warrior and Tombigbee rivers), and resulted in obtaining an unobstructed channel, with 3 feet depth of water, from the mouth up to Tompkin's Bluff, 145 miles, with a 2-foot depth from there up to Kirkpatrick's, 63 miles, and 1 foot depth from there up to Vienna, 74 miles. A considerable portion of the sum expended has been used in preservation of the improvement previously made.

The amount expended in the fiscal year ending June 30, 1891, was $257.98, and has been used in care of property.

This section of the river having been divided and covered by the act of September 19, 1890, and under other designation, should hereafter be omitted.

July 1, 1890, balance unexpended	$269.36
June 30, 1891, amount expended during fiscal year	257.98
July 1, 1891, balance unexpended	11.38

e. Tombigbee River, Alabama, from its mouth up to Demopolis.—The present project for the improvement of this section of the river was adopted in 1890, the object being to secure a channel of 6 feet depth at low water by removal of logs, snags, and bank revetment, and con-

struction of locks and dams, at an estimated cost of $508,898. At the present time the channel has a minimum depth of 2 feet.

The amount expended during the fiscal year ending June 30, 1891, is $9,648.98, and has resulted in completing the improvement of 65 miles of the lower and best part of the river and the partial improvement of 37½ miles more.

The entire length of this section is 191 miles.

The amount available is to be used in removal of snags, logs, and overhanging trees, improvement of Harwell Bar by dredging and of McGrew and Pierson shoals by blasting.

Amount appropriated by act approved September 19, 1890	$55,000.00
June 30, 1891, amount expended during fiscal year	9,648.98
July 1, 1891, balance unexpended	45,351.02
July 1, 1891, amount covered by uncompleted contracts	12,000.00
July 1, 1891, balance available	33,351.02
Amount (estimated) required for completion of existing project	453,808.00
Amount that can be profitably expended in fiscal year ending June 30,1893	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

f. Tombigbee River, from Demopolis, Alabama, to Columbus, Mississippi.—The present project for the improvement of this section of the river was adopted in 1890, the object being to obtain a channel of 6 feet depth at an ordinary low water by removal of logs, snags, etc., bank revetment, and construction of locks and dams, at an estimated cost of $779,400.

The present channel has a minimum depth of 1 foot.

The amount expended during the fiscal year ending June 30, 1891, is $288, and has resulted in the preparation of a portion of the plant and the commencement of the work proper.

The amount available is to be used in the removal of snags, logs, overhanging trees, and repair of jetties.

Amount appropriated by act approved September 19, 1890	$15,000.00
June 30, 1891, amount expended during fiscal year	288.00
July 1, 1891, balance unexpended	14,712.00
Amount (estimated) required for completion of existing project	764,400.00
Amount that can be profitably expended in fiscal year ending June 30,1893	250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 2.)

3. *Black Warrior River, Alabama, from Tuscaloosa to Daniels Creek.*—The present project for the improvement of this section of the river was adopted in 1886, the object being to afford a waterway for the transportation of coal, iron ore, iron, etc., in barges from the Warrior coal fields to the Gulf of Mexico by the construction of five locks and dams, at an estimated cost of $741,670.

The present channel is only navigable during very high water, and is even then extremely dangerous. The amount expended to June 30, 1890, was $188,165.44. This was used in necessary surveys, preparation of plan and estimates, acquisition of land for site for Lock No. 1, erection of lock-tender's house and buildings required for quarters, kitchen, storerooms, tool rooms, cement warehouses, blacksmith shop and shed, and construction of two boats; clearing of lock site, excavation of foundation pit for bank wall, stripping of quarry, grading

of track from lock to quarry, construction of cofferdam, laying track from the lock to the quarry $1\frac{3}{4}$, miles; making two inclines from the bank into the lock chamber, framing and setting up nineteen derricks, construction of boat for derrick and two barges, quarrying of 7,811 cubic yards of stone, cutting of 2,364 cubic yards of stone, laying of 1,434 cubic yards of masonry, excavation of 816 cubic yards of rock and 1,500 cubic yards of earth foundation, completion of the river wall of Lock No. 1, except the placing of six pieces of coping; the construction of breast wall for needle dam and trestles, construction of more than half of the lift wall, completion of excavation of lock chamber, except 1,000 yards, and commencement of base of dam.

The amount expended during the fiscal year ending June 30, 1891, is $46,278.92, and resulted in completing masonry of Lock No. 1, renewing the outfit, construction of new road from the city to the works, relaying the track to the quarry for the use of a locomotive instead of mules, construction of cofferdams for locks Nos. 2, and 3, with inclines 3,000 feet long, grading done to them, and the following:

	Yards.
Masonry laid	7,262
Dry masonry laid	248
Stone cut	950
Stone quarried	4,100
Rock excavated in lock chamber	1,541
Earth excavated for bank wall	3,780
Rock placed in dam	800
Rock placed behind bank wall	600
Earth placed behind bank wall	941
Trestles for needle dam constructed	5

The present condition of the work is as follows:

Lock No. 1: Locktender's house built and used at present as an engineer's office.

Masonry completed except laying the bank-wall coping, which is in readiness. Area back of bank wall paved, and bank sloped and turfed.

A flight of fifty steps down to the lock has been constructed.

Base of dam leveled up to elevation (106), the crest being at 114; 1,300 yards of stone for dam on hand.

Lock No. 2: Cofferdam (550 feet long) built, and pump and boiler placed in position for pumping. Incline into lock chamber graded, 1,500 feet long.

	Yards.
Cut stone on hand	994
Rough ashlar on hand	130
Backing on hand	2,600
Sand for mortar delivered	850

Lock No. 3: Cofferdam, 1,330 feet long, completed, inclosing also 7 acres of river bed for quarry. Incline to lock and quarry graded, 1,500 feet long.

The amount available and the appropriation asked for is to be expended in construction of the remaining locks and dams.

July 1, 1890, balance unexpended	$8,200.55
Amount appropriated by act approved September 19, 1890	150,000.00
	158,200.55
June 30, 1891, amount expended during fiscal year	49,622.04
July 1, 1891, balance unexpended	108,578.51
July 1, 1891, outstanding liabilities	6,818.49
July 1, 1891, balance available	101,760.02

Amount (estimated) required for completion of existing project	$385,420.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	385,420.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 3.)

4. *Noxubee River, Mississippi.*—The present project for the improvement of this river was adopted in 1880, the object being to afford a channel for small river steamers from its mouth up to Macon, Miss., of navigable width and depth when the water is above ordinary low-water stage.

The amount expended during the fiscal year ending June 30, 1889, was $47,527.52, and resulted in completion of the project.

The amount expended during the fiscal year ending June 30, 1890, was $2,185.02, in preservation of the improvement.

The amount expended during the fiscal year ending June 30, 1891, is $30, in care and preservation of property.

July 1, 1890, balance unexpended	$287.46
Amount appropriated by act approved September 19, 1890	3,000.00
	3,287.46
June 30, 1891, amount expended during fiscal year	30.00
July 1, 1891, balance unexpended	3,257.46

Amount (estimated) required for preservation of improvement	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 4.)

5. *Pascagoula River, Mississippi.*—The present project for the improvement of this river was adopted in 1886, the object being to afford a channel of navigable width and and minimum depth of 12 feet at mean low water from Moss Point down to the anchorage in the sound and to maintain the river above Moss Point in its improved condition, at an estimated cost of $78,100 for the channel from Moss Point down, and $2,500 annually for preservation of improvement above Moss Point.

The channel over the bar before the improvement commenced had a least depth of 3 feet. This was increased to 7½ feet with a width of 180 feet by dredging, from 1878 to 1880, at a cost of about $42,500.

From the light-house near the mouth of the river to its head there is a navigable channel, obtained by the removal of snags and overhanging trees, from 1881 to 1884, inclusive, at a cost of about $15,000.

The amount expended to June 30, 1890, is $29,843.82 and resulted in the completion of more than one-half of the work needed to complete the project from Moss Point to the mouth of the river.

The amount expended during the fiscal year ending June 30, 1891, was $16,487.09 and resulted in the completion of about one-third of the work needed to complete the project from the mouth of the river over the bar. The officer in charge reports that it has been necessary to increase the estimate for completion of this work owing to the hardness of a portion of the material to be dredged.

The amount available is to be expended in the further improvement of the channel, according to project, and in the removal of such obstructions in the river above Moss Point as have lodged during the suspension of work.

July 1, 1890, balance unexpended		$20,761.43
Amount appropriated by act approved September 19, 1890		20,000.00
		40,761.43
June 30, 1891, amount expended during fiscal year		24,928.40
July 1, 1891, balance unexpended		15,833.03
July 1, 1891, outstanding liabilities	$4,127.99	
July 1, 1891, amount covered by uncompleted contracts	7,548.80	
		11,676.79
July 1, 1891, balance available		4,156.24
Amount (estimated) required for completion of existing project		69,000.00
Amount (estimated) required for preservation of improvement above Moss Point		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		79,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 5.)

6. *Chickasahay River, Mississippi.*—The project for the improvement of this river was adopted in 1890, the object being to obtain a good high water channel from the mouth up to the railroad bridge near Shubuta, by the removal of snags, logs, and overhanging trees, at an estimated cost of $30,000.

Nothing has been expended up to the close of the fiscal year, but plant for use on the improvement is in course of construction.

Amount appropriated by act approved September 19, 1890	$5,000.00
July 1, 1891, balance unexpended	5,000.00
July 1, 1891, amount covered by uncompleted contracts	1,250.00
July 1, 1891, balance available	3,750.00
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 6.)

7. *Bluff Creek, Mississippi.*—The project for the improvement of this creek was adopted in 1890, the object being to obtain a channel from the mouth up to Vancleaves by the removal of snags, logs, and overhanging trees, at an estimated cost of $1,000.

Nothing has been expended up to the close of the fiscal year.

Amount appropriated by act approved September 19, 1890	$1,000.00
July 1, 1891, balance unexpended	1,000.00

(See Appendix Q 7.)

8. *Leaf River, Mississippi.*—The project for the improvement of this river was adopted in 1890, the object being to obtain a high-water channel from the mouth to the mouth of Bowie Creek by the removal of logs, snags, and overhanging trees, at an estimated cost of $25,000.

Nothing has been expended up to the close of the present fiscal year, but plant for use on the improvement is in course of construction.

Amount appropriated by act approved September 19, 1890	$5,000.00
July 1, 1891, balance unexpended	5,000.00
July 1, 1891, amount covered by uncompleted contracts	1,250.00
July 1, 1891, balance available	3,750.00

Amount (estimated) required for completion of existing project	$20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 8.)

9. *Harbor at Biloxi, Mississippi.*—The present project for the improvement of this harbor was adopted in 1882, the object being to afford a channel of entrance from Mississippi Sound to the wharves at Biloxi of navigable width and 8 feet deep, at an estimated cost of $55,000; the channel before was 4½ feet deep at the shoalest part.

The amount expended to June 30, 1890, was $17,628.55 and resulted in dredging a channel 9 feet deep at mean low water throughout and 126 feet wide for a distance of 2,150 feet, thence 84 feet wide for a further distance of 2,000 feet, and thence 124 feet wide for a further distance of 1,030 feet.

The amount expended during the fiscal year ending June 30, 1891, is $16,487.09 and resulted in obtaining a channel 9 feet deep and 120 feet wide throughout and completion of the project.

July 1, 1890, balance unexpended		$18,371.45
Amount appropriated by act approved September 19, 1890		9,000.00
		27,371.45
June 30, 1891, amount expended during fiscal year		16,520.09
July 1, 1891, balance unexpended		10,851.36

(See Appendix Q 9.)

10. *Pearl River, Mississippi, below Jackson.*—The present project for the improvement of this portion of the river was adopted in 1885, the object being to afford a channel 2 feet deep at ordinary low water and of navigable width from the mouth of the river up to Jackson, at an estimated cost of $145,940. Before the improvement the river was not navigable at all at low water, and difficult at high water. The amount expended on the work to June 30, 1890, was $103,103.55 and resulted in the complete improvement of that section of the river from the mouth at the Rigolets up to Wheats Field, a distance of 106 miles, and the partial improvement of the river from Wheats Field to Jackson, a distance of 208 miles.

The amount expended during the fiscal year ending June 30, 1891, was $1,335.25, and resulted in the construction of a log flat.

Condition of this part of the river is now such that light-draft boats can navigate from the mouth at the Rigolets, La., to Wheats Field, Miss., 106 miles, all the year; from Wheats Field up to Columbia, Miss., 50 miles, on a 6-foot rise, and from Columbia to Jackson on a 7-foot rise.

July 1, 1890, balance unexpended		$4,021.45
Amount appropriated by act approved September 19, 1890		20,000.00
		24,021.45
June 30, 1891, amount expended during fiscal year		1,335.25
July 1, 1891, balance unexpended		22,686.20
Amount (estimated) required for completion of existing project		35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix Q 10.)

11. *Pearl River, Mississippi, between Jackson and Carthage.*—The present project for the improvement of this portion of the river was adopted in 1887, the object being to obtain a channel of 2 feet depth at low water and of navigable width throughout, at an estimated cost of $50,000.

Before the improvement was commenced navigation, even during high water, was difficult on account of snags and overhanging trees.

The amount expended to June 30, 1890, was $23,146.73, and resulted in such improvement of 102 miles of river from Carthage down, that boats of 3-foot draft of water could navigate this distance on a 3-foot rise above ordinary low water, and the remaining distance (3 miles) on a 4-foot rise.

The amount expended during the fiscal year ending June 30, 1891, is $1,632.37.

July 1, 1890, balance unexpended	$103.27
Amount appropriated by act approved September 19, 1890	3,000.00
	3,103.27
June 30, 1891, amount expended during fiscal year	1,632.37
July 1, 1891, balance unexpended	1,470.90
Amount (estimated) required for completion of existing project	23,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	23,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 11.)

12. *Pearl River, Mississippi, between Edinburg and Carthage.*—The project for the improvement of this portion of the river was adopted in 1884, the object being to obtain a good high-water channel, at an estimated cost of $13,464. Before the improvement was commenced navigation was only possible during very high water, and was even then troublesome. The amount expended up to the close of the fiscal year ending June 30, 1890, was $5,857.08, and resulted in the completion of the project.

The amount expended during the fiscal year ending June 30, 1891, was $600.66.

July 1, 1890, balance unexpended	$629.53
Amount appropriated by act approved September 19, 1890	5,000.00
	5,629.53
June 30, 1891, amount expended during fiscal year	600.66
July 1, 1891, balance unexpended	5,028.87
Amount (estimated) required for preservation of improvement	500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q 12.)

13. *Bogue Chitto, Louisiana.*—The project for the improvement of this river was adopted in 1890, the object being to obtain a 3-foot channel during the greater part of the year by the removal of logs, snags, fish traps, etc., from the mouth up to Alfords Bridge, at an estimated cost of $30,000.

Nothing has been expended up to the close of the present fiscal year, but plant for use on the improvement is in course of construction.

Amount appropriated by act approved September 19, 1890	$5,000.00
July 1, 1891, balance unexpended	5,000.00
July 1, 1891, amount covered by uncompleted contracts	1,250.00
July 1, 1891, balance available	3,750.00
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q 13.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Sucarnochee River, Alabama, from its mouth to the Mobile and Ohio Railroad Bridge*, was made by the local engineer in charge, Major Damrell, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Major Damrell, based upon the facts and reasons given, that, although this river is worthy of improvement to a certain extent, it is probably of less importance than any river in charge of his office, and work on it should be postponed until the more important ones are finished. In view of the estimated cost of improvement Colonel Comstock does not consider the river worthy of improvement by the United States. The views of Colonel Comstock being concurred in by me, no further survey was ordered. The report was transmitted to Congress, and printed as House Ex. Doc. No. 116, Fifty-first Congress, second session. (See also Appendix Q 14.)

INSPECTION OF THE IMPROVEMENT OF THE SOUTH PASS OF THE MISSISSIPPI RIVER.

Inspecting officers, Capt. W. L. Fisk, Corps of Engineers, to January 31, 1891, and Maj. James B. Quinn, Corps of Engineers, since that date.

The inspecting officer in his annual report states that the legal channel was maintained through South Pass itself, except for 3 days in April, when at one point the depth was 25 feet, and for 12 days the jetty channel had a central depth of from 27.5 to 29.4 feet.

Beyond the ends of the jetties, and on a direct course, the least depth during the year was 26 feet, but in the channel turning to the eastward a depth of more than 30 feet was maintained.

Aside from the exception mentioned, the least depth from the Head of the Passes to the Gulf during the year was 27 feet, and the least width of the 26-foot channel was 160 feet.

In the fan-shaped area beyond the ends of the jetties there was an average shoaling of 2.7 feet during the year.

July 1, 1890, balance unexpended	$11,042.27
Amount appropriated by act approved August 11, 1888	10,000.00
	21,042.27
June 30, 1891, amount expended during fiscal year	11,042.27
July 1, 1891, balance unexpended	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,210.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R.)

IMPROVEMENT OF CERTAIN STREAMS IN LOUISIANA, AND OF HARBOR AT SABINE PASS, SABINE RIVER, AND NECHES RIVER, TEXAS.

Officers in charge, Capt. W. L. Fisk, Corps of Engineers, to January 31, 1891, and Maj. James B. Quinn, Corps of Engineers, since that date; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Chefuncte (Tchefuncte) River and Bogue Falia, Louisiana.*—The river is navigable for steamers drawing 5 feet to Old Landing, about 10 or 12 miles above its mouth, and then for the lighter-draft schooners to Covington, about 2 miles farther up on the Bogue Falia. The bar at the mouth of the river had a depth of 4½ feet on it at the lowest stage of the water.

The project for the improvement of the river was made in 1880, and contemplated the removal of overhanging trees, logs, etc., in the channel and the dredging of the bar at its mouth.

The obstructions, such as overhanging trees, logs, etc., were removed, but the bar at the mouth was not dredged, as it would be likely to re-form.

To prevent this or retard its re-formation, the officer in charge in 1884 recommended building a breakwater extending 2,500 feet into the lake and then dredging a channel through the bar.

With the two appropriations of $1,500 each, made in 1881 and 1882, the obstructions below Covington were removed and part of the unexpended balance was used for the construction of 820 feet of the breakwater.

The original estimated cost of improving the river was $5,460, but this did not include building a breakwater across the bar.

At the close of the fiscal year ending June 30, 1885, $3,000 had been expended on this improvement, at which time the navigation had been improved for schooners to Covington by removal of snags and overhanging trees, and it is thought that the breakwater has retarded the drift of sand on the bar at the river's mouth.

Twenty-five hundred dollars was appropriated by Congress in August, 1886, to improve Bogue Falia between Old Landing and Covington.

Early in 1887 operations began and channels 5 feet in depth and 30 to 60 feet wide were cut through the bars in this stretch of bayou, giving better navigation for schooners to and from Covington.

The $1,000 appropriated in 1890 has not been expended yet, but will be used in removing snags and similar obstructions as soon as the Government plant now employed in the improvement of the Amite River is released.

One thousand dollars can be profitably expended on this river and bayou next season.

The sum of $5,425 has been expended on this stream up to the close of the fiscal year ending June 30, 1891.

Amount appropriated by act approved September 19, 1890	$1,000.00
July 1, 1891, balance unexpended	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S 1.)

2. *Tickfaw River and its tributaries, Louisiana.*—In 1879 Congress authorized an examination of this river. A project was submitted in 1881 to clean out the river and its navigable branches, the Natalbany, Blood and Ponchatoula rivers, by removing logs, snags, trees, etc., at an estimated cost of $10,230.

In 1881, 1882, 1886, and 1888 Congress made appropriations aggregating $7,000, and 20 miles of the Tickfaw, and the Natalbany to Springfield, the head of navigation, have been improved. Work was also done on the Ponchatoula as far as it was thought advisable.

The Blood River was also cleaned out as far as navigable.

Only a little wood and some saw-logs are carried or floated on this stream.

The improvement is not permanent, as obstructions will continue to form in all these streams, but an annual appropriation of $1,000 will keep them in good order.

With the appropriation of 1886 the work was completed according to the original project, but obstructions having re-formed in the mean time it was necessary to use the appropriation of 1888, $1,000, for removing them.

In 1890 $1,000 was appropriated for continuation of improvement, but nothing has been done yet, owing to the Government plant with which the work is to be done, being engaged elsewhere.

The amount expended on this stream to June 30, 1891, was $7,000.

Amount appropriated by act approved September 19, 1890	$1,000.00
July 1, 1891, balance unexpended	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,000.00

(See Appendix S 2.)

3. *Amite River and Bayou Manchac, Louisiana.*—The Amite River and its principal tributary, Bayou Manchac, were navigable by the ordinary river steamboat below and for a short distance above their point of junction, but the navigation was very much impeded and endangered by snags, stumps, and impending trees.

In 1880 a project was adopted for the improvement of the Amite River, providing for a low-water channel 5 feet in depth as far up-stream as appropriations would permit, the main part of the work to be done above the mouth of the Bayou Manchac.

In 1880 $8,000 was appropriated for this work, and in 1881 $5,000. An effort to do the work by contract was made, but the results were unsatisfactory, and in 1883 the original project was modified so as to permit the use of Government plant and hire of labor on the work, the improvement to be made below the mouth of the Bayou Manchac. In 1886 $2,000 was appropriated for this improvement, and work was resumed with the Government plant and hired labor. The obstructions to the navigation below the mouth of the Manchac were removed, leaving the river in good shape.

In 1890 an appropriation of $3,800 was made for the improvement of the Amite River and Bayou Manchac, leaving the amounts to be expended upon each discretionary with the engineers. During the year the work has been confined to clearing the bayou of logs, snags, and impending trees for a distance of about 2½ miles above Hope Villa and from Hope Villa to the junction with the Amite River, leaving both streams in fairly good condition.

Owing to the caving of the banks of these streams, the permanent improvement is hardly possible, and about $2,500 will be required annually to keep them clear of the obstructions caused by drift.

At the end of the fiscal year just closed $22,667.86 had been expended on this work.

July 1, 1890, balance unexpended	$514.04
Amount appropriated by act approved September 19, 1890	3,800.00
	4,314.04
June 30, 1891, amount expended during fiscal year	3,191.90
July 1, 1891, balance unexpended	1,122.14
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	2,500.00

(See Appendix S 3.)

4. *Bayou La Fourche, Louisiana.*—Prior to 1879 the navigation of Bayou La Fourche was very much obstructed by snags, logs, raft-heaps, impending trees, and wrecks. In 1879 a project for the removal of these obstructions was approved, and under the project work was carried on until 1885, during which time $28,754.45 was expended, resulting in giving much relief to navigation.

In 1888 Congress appropriated $50,000 for the improvement of the bayou, on the plan of Lieutenant Crosby, Corps of Engineers, dated June 11, 1886, and provided for dredging for the immediate relief of low-water navigation.

Lieutenant Crosby's project was for a lock at the head of the bayou, connecting it with the Mississippi River, and subsequent dredging of the bayou channel to a width of 75 feet, with a depth of 5 feet at mean low water of the Gulf. The estimated cost was $450,000, with an annual expenditure of $8,000 for operation and maintenance.

Under the provision of this act dredging was commenced at the head of the bayou, and has been continued since, with considerable benefit to the low-water navigation.

Dredging is a very unsatisfactory method of improvement, since much of the work has to be gone over again after the subsidence of the flood in the Mississippi River. If the lock was constructed, whatever dredging was thereafter done in the bayou would be practically permanent and the certainty and safety of the navigation of the bayou assured.

Up to the close of the fiscal year, June 30, 1891, there has been expended on this stream the sum of $57,283.44.

July 1, 1890, balance unexpended	$35,407.49
Amount appropriated by act approved September 19, 1890	50,000.00
	85,407.49
June 30, 1891, amount expended during fiscal year	12,690.93
July 1, 1891, balance unexpended	72,716.56
Amount (estimated) required for completion of existing project	400,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	100,000.00

(See Appendix S 4.)

5. *Bayou Terrebonne, Louisiana.*—The estimated cost of the improvement of this bayou was $38,800. The project called for the dredging of a channel 4 feet deep at mean low water of the Gulf to Houma.

When work was commenced in 1880 Bayou Terrebonne was little better than a drainage ditch, being about 11 feet wide when dredging began. The completion of the work to Houma as projected cost $35,808, enabling planters to float their merchandise to Houma or else to New Orleans by connecting bayous and canals.

July 1, 1890, balance unexpended	$2,994.79
June 30, 1891, amount expended during fiscal year	2.79
July 1, 1891, balance unexpended	2,992.00

(See Appendix S 5.)

6. *Bayou Plaquemine, Louisiana.*—Previous to the closing of the mouth of Bayou Plaquemine by a dam in 1867 or 1868 the largest steamboat passed through it into Grand Lake and the numerous water routes connected with it.

In 1885 a project was proposed for reëstablishing this water route by building a lock at the head of the bayou and dredging out the channel below. In 1888, $100,000 was appropriated for improving the bayou and protecting the bank at its mouth from caving; $75,000 of this sum was allotted to bank protection; the remainder has been devoted to dredging out the bayou so as to give a channel 60 feet wide and 6 feet deep at mean low-water level of the Gulf.

This dredging is still in progress, the Government dredge and hired labor being employed. About half the channel is completed.

In 1890, $100,000 was appropriated for continuing improvement.

Of this sum $60,000 was allotted for bank protection. For the expenditure of the remainder a project for the purchase of property and right of way for a lock at Plaquemine was presented but has not yet been approved.

Up to the close of the fiscal year ending June 30, 1891, there had been expended on this stream from funds allotted to this office the sum of $16,984.31.

*July 1, 1890, balance unexpended	$53,605.44
Amount appropriated by act approved September 19, 1890	100,000.00
	153,605.44
June 30, 1891, amount expended during fiscal year	21,542.01
July 1, 1891, balance unexpended	132,063.43
Amount (estimated) required for completion of existing project	1,508,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix S 6.)

7. *Bayou Courtableau, Louisiana.*—During the high-water season the backwater from the Atchafalaya always forms a large sand deposit known as Little Devil Bar at the mouth of the Courtableau.

When the water fell a number of small bayous on the lower side of the Courtableau formerly allowed so much water to escape into the swamps that there was not sufficient current to scour out Little Devil Bar, and during low water it was necessary to transfer freight around it by a tramway.

An examination was made in 1879, and the cost of improvement below Port Barre was estimated at $40,000, the project being to close the run-out bayous, forcing all the water to flow over Little Devil Bar and scour it out, after which a timber lock and dam were to be constructed to give slack-water navigation to Washington, La. In 1883 the estimate was increased to $78,500, and provided for a masonry lock. Up to June 30, 1889, there had been appropriated $29,000, of which $27,910.61 had been expended in closing run-out bayous, with the effect of partially removing the bar.

*The money statement for securing mouth of Bayou Plaquemine from further caving (page 231) is consolidated with this.

During 1890 a few repairs were made to the plant, but nothing was done upon the dams, owing to high water, and nothing has been done this year so far for the reason it is very doubtful if, with all the run-outs closed, a channel navigable at low water can be maintained over Little Devil Bar, which, under any circumstances, will certainly form again at each high water of the Atchafalaya.

No funds are asked for next year.

The amount expended on this stream to June 30, 1891, was $28,374.87.

July 1, 1890, balance unexpended	$1,089.39
Amount appropriated by act approved September 19, 1890	2,200.00
	3,289,39
June 30, 1891, amount expended during fiscal year	464.26
July 1, 1891, balance unexpended	2,825.13

(See Appendix S 7.)

8. *Bayou Teche, Louisiana.*—This bayou is navigated ordinarily by steamboats throughout the year.

Prior to 1886 navigation was obstructed by logs, snags, and impending trees, but money having been appropriated the stream was thoroughly cleared of such obstructions from Port Barre down. Since the completion of this work some further obstructions have found their way into the bayou, and in 1890 $5,000 was appropriated with which to accomplish their removal.

Under this appropriation it is proposed to remove the logs, snags, etc., by hired labor, using the Government plant now laid up on the Bayou Courtableau. Nothing has yet been done on account of high water, but as soon as the water subsides sufficiently work will be commenced.

July 1, 1890, balance unexpended	$462.08
Amount appropriated by act approved September 19, 1890	5,000.00
	5,462.08
June 30, 1891, amount expended during fiscal year	40.24
July 1, 1891, balance unexpended	5,421.84

(See Appendix S 8.)

9. *Mouth and passes of Calcasieu River, Louisiana.*—Previous to any improvement there was but 3 feet depth in the Calcasieu Passes.

In 1874, 1883, and 1888 channels were dredged through the bars in Calcasieu Lake or at what is known as the passes of Calcasieu River. As no permanent system of revetment was employed the dredged channel was soon obliterated.

In 1888 an appropriation of $10,000 for continuing this improvement was made, but as at least $150,000 will be required to give anything like a permanent channel through the bars the money has been held for future consideration.

In 1890 $75,000 was appropriated for the improvement of the mouth of the Calcasieu River, but as the work of jetty construction proposed was in an exposed locality the amount was not deemed sufficient with which to commence operations economically and it has consequently been held for future increase.

The early construction of a secure channel through the bars in Calcasieu Lake is urgently needed, as it will give water transportation for the products of the mills on Calcasieu River and result in a saving to the consumers of about $40,000 annually on this item alone. The improvement of the mouth of the river will afford a harbor of refuge and be an extension of the foregoing improvement.

Upon the channels in Calcasieu Lake $150,000 can be expended profitably, and about $200,000 upon the improvement of the mouth also during the ensuing year.

Up to the close of the fiscal year ending June 30, 1891, $19,245.31 had been expended on this stream.

July 1, 1890, balance unexpended		$9,977.00
Amount appropriated by act approved September 19, 1890		75,000.00
		84,977.00
June 30, 1891, amount expended during fiscal year		41.60
July 1, 1891, balance unexpended		84,935.40
Amount (estimated) required for completion of existing project		525,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		350,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix S 9.)

10. *Harbor at Sabine Pass, Texas.*—Originally the bar obstructing the entrance to the harbor of Sabine Pass had not 5 feet of water upon it. In 1878 and 1880 channels from 12 to 16 feet deep were dredged through it, but they soon filled up. In 1882 a project was approved for the improvement of the entrance by constructing jetties and dredging, if necessary. The estimated cost of this improvement was $3,177,606.50.

Since the approval of this project there has been appropriated $1,098,750, of which amount there remains $300,000 to be expended this season under contract approved May 27, 1891.

The east jetty has a total length of 17,100 feet; the outer 450 feet is foundation work solely. A section of this jetty at the outer end, 240 feet long, was given a width of 112 feet at the foundation, and was capped with rock weighing from 1 to 3 tons. Its crest was 4½ feet above mean low water.

The west jetty is 9,500 feet long. Its outer end lacks about 4,000 feet of being abreast of the outer end of the east jetty; 2,500 feet of this jetty is, properly speaking, but foundation work.

The east jetty at its outer end has suffered some loss of height since the last examination in 1890, but whether this loss is owing to a subsidence or displacement of rock due to wave action can not be determined definitely.

The 12-foot curve of depth has advanced some on the inside and the channel is wider. It has not changed its position much on the seaward side. The channel of 10 feet depth is continuous and about 1,000 feet wide. A good deal of shoaling has occurred behind the west jetty, and the shore has advanced some.

Considering the incomplete character of the work the conditions are considered encouraging.

A total of $1,120,422.44 has been expended to June 30, 1891, of which sum $800,422.44 was expended under the present project.

July 1, 1890, balance unexpended		$3,814.03
Amount appropriated by act approved September 19, 1890		300,000.00
		303,814.03
June 30, 1891, amount expended during fiscal year		5,486.47
July 1, 1891, balance unexpended		298,327.56
July 1, 1891, outstanding liabilities	$1,268.94	
July 1, 1891, amount covered by uncompleted contracts	270,000.00	
		271,268.94
July 1, 1891, balance available		27,058.62

Amount (estimated) required for completion of existing project	$2,078,856.50
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S 10.)

11. *Sabine River, Texas.*—At the commencement of the improvement of the river there was a depth of 3½ feet on the bar at its mouth and also above the town of Orange. Logs, snags, etc., above here interfered with navigation. To June 30, 1889, there had been appropriated for this work $34,700, of which $30,760.39 had been expended.

In 1880 a channel 6 feet deep, 70 to 100 feet wide, was dredged through the bar. In 1881 several small cuts, to avoid bends obstructed with logs, were made above Orange.

The dredged channel over the bar at the mouth is somewhat obstructed by logs, but the depth is now sufficient for present demands of navigation and commerce.

An examination above Orange showed many snags in parts of the channel and a project was prepared and contract entered into for the expenditure of the remaining balance in closing both branches of Old River at the head of the Narrows with pile, brush, and earth dams, to throw all the water into the useful channel, and removing the snags, overhanging trees, etc.

The smaller Old River channel was closed and most of the piles driven for the larger dam, when a sudden rise in the river washed out many of the piles in the latter. The river remaining so high that satisfactory work could not be done, the contract was extended to the next low-water season. Work was resumed in September, 1890, and the dams finished, as projected, in December following, completing the project.

The amount expended on this stream to June 30, 1891, was $34,614.12.

July 1, 1890, balance unexpended	$3,939.61
June 30, 1891, amount expended during fiscal year	3,852.73
July 1, 1891, balance unexpended	86.88

(See Appendix S 11.)

12. *Neches River, Texas.*—Before this river was improved the bar at its mouth had only 3 feet of water over it, and snags and fallen trees obstructed navigation between Yellow Bluff and Bevilsport. To June 30, 1890, $33,000 had been appropriated for this work, of which $28,842.16 had been expended.

In 1880 a channel was dredged through the bar at the mouth of the river 5 feet deep and 30 to 60 feet in width. In 1882 the river between Yellow Bluff and Bevilsport was cleared of obstructions.

The bar at the mouth had again shoaled, so that at extreme low water there was only a navigable depth of about 3 feet. The channel was dredged to a depth of 5 feet by the Government dredge, which had been at work at Calcasieu Pass, and the work was completed in May, 1889, since which time no work has been done.

The improvement will not be permanent, as the bar will reform.

July 1, 1890, balance unexpended	$4,157.84
July 1, 1891, balance unexpended	4,157.84

(See Appendix S 12.)

13. *Removing sunken vessels or craft obstructing or endangering navigation.*—The removal of wreck of the British bark *Bruce*, sunk in Ship

Island Harbor, Mississippi, in December, 1890, was commenced, under contract with the Alabama Dredging and Jetty Company for the sum of $1,490, on June 19, 1891, and is now in process of execution.

(See Appendix S 13.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED JULY 5, 1884.

The preliminary examination of *Bayou Carlin, Louisiana*, required by the act of July 5, 1884, was not made at the time, owing, as stated in the Annual Report of the Chief of Engineers for 1885, page 244, to an uncertainty as to the locality intended by the act. Recent correspondence having elicited information as to the location of the bayou, the local engineer in charge, Major Quinn, made an examination of it and submitted report thereon, through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Major Quinn, based upon the facts and reasons given, that this locality is worthy of improvement; but Colonel Comstock, for reasons stated, does not consider the improvement worthy of being made by the United States. The views of Colonel Comstock being concurred in by me, no further survey was ordered. (See Appendix S 14.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Fisk, Major Quinn's predecessor, and reports thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Fisk, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys of these localities were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Shoals on Lake Pontchartrain, Louisiana, near the Rigolets, known as the "Middle Ground," with a view of dredging a channel* 10 *feet deep and revetting sides of the same.*—Printed as House Ex. Doc. No. 111. (See also Appendix S 15.)

2. *Bayou Chevreuil and Bayou Tigre, Louisiana, from Lake Des Allemands to points near Vacherie, Chigby and Malagay settlements in St. James Parish for removal of bars and other obstructions to navigation.*—Printed as House Ex. Doc. No. 182. (See also Appendix S 16.)

3. *Bayou Terre Bonne, Louisiana, from Houma to Thibodeaux.*—Printed as House Ex. Doc. No. 110. (See also Appendix S 17.)

4. *Bayou Black to connect with Terre Bonne, Louisiana.*—Printed as House Ex. Doc. No. 113. (See also Appendix S 18.)

5. *Berwick's Bay, Louisiana, to the Gulf, with a view of obtaining a deeper channel.*—Printed as House Ex. Doc. No. 198. (See also Appendix S 19.)

6. *Bayou Cocodrie, in St. Landry Parish, Louisiana.*—Printed as House Ex. Doc. No. 114. (See also Appendix S 20.)

7. *Bayou Black, Louisiana, for connection between Calcasieu Lake and Sabine Lake.*—Printed as House Ex. Doc. No. 125. (See also Appendix S 21.)

The required preliminary examination of *Bayou Teche, Louisiana, from St. Martinsville to Port Barre*, was made by the local engineer in charge, Captain Fisk, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Fisk, based upon the facts and reasons given, that this locality is worthy of improvement; but Colonel Comstock does not consider this reach of Bayou Teche worthy of being improved by the United States. The views of Colonel Comstock being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 280, Fifty-first Congress, second session. (See also Appendix S 22.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Fisk, and reports thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Fisk, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The reports of the preliminary examinations containing sufficient information to indicate to Congress the probable cost of the work required, no further surveys appear to be necessary at this time. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Bayou Des Glaises, Louisiana, with a view of clearing the stream of obstructions from the Atchafalaya River to Cottonport.*—The proposed improvement contemplates the removal of overhanging trees, at an estimated cost of $2,500. Printed as House Ex. Doc. No. 119. (See also Appendix S 23.)

2. *Bayou Vermillion, bay and passes, Louisiana.*—The proposed improvement contemplates clearing the stream of obstructions to such an extent as to allow 5½ feet of water to be carried up to the crossing of the Southern Pacific Railroad, at an estimated cost of $25,000. Printed as House Ex. Doc. No. 273. (See also Appendix S 24.)

The required preliminary examination of *Mermenton (Mermentau) River, Louisiana, including its tributaries and course through Lake Arthur and Grand Lake to the Gulf of Mexico*, was made by the local engineer in charge, Captain Fisk, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Fisk, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Captain Fisk, was charged with its survey. His successor, Major Quinn, has completed this duty and submitted report thereon. The proposed improvement contemplates clearing the stream of obstructions from Viterboville to the mouth, and construction of a brush dam at Lower Mud Lake, at an estimated cost of $23,615.25; and the construction of jetties at the mouth, to give deep water over the bar, at an estimated cost of $781,210. (See Appendix S 25.)

Captain Fisk was charged with the required preliminary examination of *Sabine River, Texas, from where said river empties in Sabine Lake to Sudduth's Bluff, on said Sabine River.* This examination is now in charge of Major Quinn, and report of the results will be duly submitted when received.

SECURING MOUTH OF BAYOU PLAQUEMINE, LOUISIANA, FROM FURTHER CAVING, AND REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION OF NEW ORLEANS HARBOR, LOUISIANA.

Officers in charge, Capt. Dan C. Kingman, Corps of Engineers, to October 27, 1890, and Lieut. John Millis, Corps of Engineers, since that date; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Securing mouth of Bayou Plaquemine, Louisiana, from further caving.*—The bank of the river at this point was formerly subject to serious caving, threatening the site of the proposed locks at the entrance to the bayou.

The project adopted for the improvement consists of submerged spur dikes built at nearly right angles to the bank above and below the entrance to the bayou at intervals of about 900 feet.

Up to the close of the fiscal year ending June 30, 1890, there had been expended $34,774.76 upon this work, and the caving had been stopped in the vicinity of the completed work. No construction work has been done during the past year, owing to the lateness of the season when the new allotment became available and the employment of the plant on other works.

An allotment of $60,000 was made for this work from the appropriation of September 19, 1890, for improving Bayou Plaquemine, La. The total amount available for the work July 1, 1891, is $84,047.74. The money statement is consolidated with that for improvement of Bayou Plaquemine, La., page 225.

(See Appendix T 1.)

2. *Removing sunken vessels or craft obstructing or endangering navigation of New Orleans Harbor, Louisiana.*—The following wrecks have been removed from the harbor of New Orleans, La., during the past year, leaving the harbor clear of such obstructions at this date; *Vallette Dry Dock* and Ship *Isle Marthe*, Elevator *Leo Gilchrist*, and steamboat *Edward J. Gay.*

(See Appendix T 2.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN TEXAS.

Officer in charge, Maj. Charles J. Allen, Corps of Engineers, with Lieut. William C. Langfitt, Corps of Engineers, under his immediate orders; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Entrance to Galveston Harbor, Texas.*—The obstructions to deep-water navigation at this harbor have been the outer and inner bars. On the former the natural depth was 12 feet, and on the latter about 13 feet, both at mean low tide.

The present project for improvement at this locality was adopted in 1874, modified in 1880, and again modified in 1886, the object being to deepen the channels so as to admit sea-going vessels of the deepest draft. The projects prior to 1874 related to dredging operations on a small scale.

The total amount expended to June 30, inclusive, 1890, was $2,158,847.41, in addition to which there were expended $100,000 subscribed by the city of Galveston in 1883. It resulted in deepening the channel over the outer bar to about 13¼ feet at mean low tide, and that over the inner bar to 21 feet. The amount expended during the year was $115,073.49. It has resulted in maintaining 13¼ feet on the outer and 21 feet on the inner bar. In accordance with the terms of the river and harbor act of Congress, approved September 19, 1890, a contract has

been entered into for completion of the entire work, which is to be pushed at such rate that the contractors shall earn not less than $1,000,000 per year provided appropriations to that extent or that rate are made by Congress. The delivery in place of the material for the work should commence not later than August 1 next.

July 1, 1890, balance unexpended		$119,152.59
Amount appropriated by act approved September 19, 1890		500,000.00
Amount appropriated by sundry civil act approved March 3, 1891		600,000.00
		1,219,152.59
June 30, 1891, amount expended during fiscal year		115,073.49
July 1, 1891, balance unexpended		1,104,079.10
July 1, 1891, outstanding liabilities	$2,372.63	
July 1, 1891, amount covered by uncompleted contracts*	1,040,000.00	
		1,042,372.63
July 1, 1891, balance available		61,706.47

Amount (estimated) required for completion of existing project	5,100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix U 1.)

2. *Ship channel in Galveston Bay, Texas.*—This is a channel dredged by the United States Government from Bolivar Channel to Morgan Cut, the latter terminating at a point 5 miles from Morgan Canal, which is an excavation across Morgan Point at the mouth of the San Jacinto River. Morgan Canal and Morgan Cut are works executed by the Buffalo Bayou Ship Channel Company, chartered under the laws of Texas.

The natural depth on the line of the Galveston Ship Channel averaged 8½ feet at mean low tide, with a depth at some places of but 7 feet.

The project for this improvement was adopted in 1871 and modified in 1877, the object being to excavate and maintain a channel 12 feet deep and 100 feet wide at bottom through Galveston Bay from Bolivar Channel to Morgan Cut, a distance of 18.9 miles.

Work upon the channel, which had been suspended in 1883, was resumed in February, 1888, and by June 20, 1889, a channel 12 feet deep and 100 feet wide at bottom had been excavated up to Morgan Cut. The average depth of excavation was 13.15 feet.

The total amount expended to June 30, 1890, was $528,686.54. It resulted in a channel having a ruling depth of 10 feet, the channel having shoaled to that depth.

The amount expended during the past fiscal year was $7,541.89, the channel at that date having a ruling depth of 9 feet. The work is not capable of permanent completion. It is estimated that an annual expenditure of $80,000 will be required to maintain it after once excavated to the required depth.

The work of improvement of the ship channel having, in July, 1889, reached the point in the bay at which the southern extremity of Morgan Cut is located, the officer in charge, under instructions from this office, called upon the Buffalo Bayou Ship Channel Company to execute its agreement of January 22, 1881, to transfer to the United States its works at Morgan Point. Congress, by act approved September 19,

* $60,000 reserved from the appropriations of September 19, 1890, and March 3, 1891, for contingencies of engineering and inspection.

1890, provided for the appointment of a Commission of United States engineers to ascertain the value of any portion of the channel from Bolivar Channel to the point where the San Jacinto River enters what is known as Morgan Canal, which might have been constructed by the Buffalo Bayou Ship Channel Company, the amount so ascertained and certified to be correct by the Secretary of War to be paid to the ship-channel company out of any money in the Treasury not otherwise appropriated. The report of the commission was made December 4, 1890, and approved and forwarded to the proper department for payment in January following. At this date the works have not been transferred to the United States.

The estimate of $200,000 herewith is the amount required to complete the excavation to a depth of 12 feet and to maintain it for 1 year thereafter.

July 1, 1890, balance unexpended	$17,813.46
Amount appropriated by act approved September 19, 1890	40,000.00
	57,813.46
June 30, 1891, amount expended during fiscal year	7,541.89
July 1, 1891, balance unexpended	50,271.57
July 1, 1891, outstanding liabilities	137.90
July 1, 1891, balance available	50,133.67
Amount that can be profitably expended in fiscal year ending June 30, 1893	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix U 2.)

3. *Trinity River, Texas.*—The natural channel on the bar at the mouth of the river was narrow and shoal. The project for improvement was adopted in 1873 and modified in 1889, the modification principally consisting in the employment of parallel timber jetties to effect the required deepening to 6 feet on the bar at the mouth of the middle pass. The total amount expended to June 30, 1890, was $46,955.57. It resulted in increasing the depth on the bar from 3 feet 2 inches to 3 feet 6 inches, and also in straightening the channel. The amount expended during the past fiscal year was $5,866.64. It has resulted in maintaining the depth of 3 feet 6 inches. The sum estimated for the fiscal year ending June 30, 1893, to be applied to the completion of the jetties.

July 1, 1890, balance unexpended	$44.43
Amount appropriated by act approved September 19, 1890	10,000.00
	10,044.43
June 30, 1891, amount expended during fiscal year	5,866.64
July 1, 1891, balance unexpended	4,177.79
July 1, 1891, outstanding liabilities	223.48
July 1, 1891, balance available	3,954.31
Amount (estimated) required for completion of existing project	32,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	32,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix U 3.)

4. *Cedar Bayou, Texas.*—A survey of this locality with a view to removal of the bar at the mouth of the bayou was made in 1889. The

natural depth on the bar was 3 feet at mean low tide. The cost of improvement to afford a depth of 5 feet was estimated as $18,150, which sum was appropriated by act of September 19, 1890. This sum will be applied this season to dredging and protection of the cut by walls of brush and stone mattress. The officer in charge estimates $14,000 as the sum that can be profitably expended during the fiscal year ending June 30, 1893, to complete the walls and for dredging.

Amount appropriated by act approved September 19, 1890	$18,150.00
July 1, 1891, balance unexpended	18,150.00
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	14,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix U 4.)

5. *Buffalo Bayou, Texas.*—The channel between the city of Houston and Simms Bayou, a distance of 11 miles, the extent of bayou under improvement was, in its natural condition, narrow and tortuous and the natural depth in many places was not more than 6 feet. The project for improvement was adopted in 1881, the object being to straighten the channel, and to widen it to 100 feet and deepen it to 12 feet; also to remove such snags, stumps, and overhanging trees as obstruct navigation. The total amount expended to June 30, 1890, was $143,691.73. It resulted in clearing the channel of the most prominent stumps, snags, and overhanging trees, in easing most of the bends and in removing such shoals as obstructed a 7-foot navigation. The amount expended during the past fiscal year was $12,008.63. It has resulted in further easement of bends and in still further relieving the channel and bends of obstructions. The obstructions are renewed in more or less degree every year, through action of floods. The project is not capable of permanent completion. The sum of $50,000, estimated for the fiscal year ending June 30, 1893, to be applied to further removal of bars and other obstructions.

July 1, 1890, balance unexpended	$58.27
Amount appropriated by act approved September 19, 1890	25,000.00
	25,058.27
June 30, 1891, amount expended during fiscal year	12,008.63
July 1, 1891, balance unexpended	13,049.64
June 1, 1891, amount covered by uncompleted contracts	9,141.93
July 1, 1891, balance available	3,907.71
Amount (estimated) required for completion of existing project	216,549.75
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix U 5.)

6. *Harbor at Brazos Santiago, Texas.*—In its natural state the channel over this bar was shifting, and its depth varied from 6 to 8 feet. The present (original) project for its improvement was adopted in 1881, the object being to fix the position of the channel over the bar at the entrance and to deepen it. The total amount expended to June 30, 1890, was $189,318.57, besides an appropriation of $6,000 in 1878, applied to removing a wreck. It has resulted in no useful effect upon the bar, and the works heretofore constructed have practically disappeared.

The amount expended during the past fiscal year was $290. It was applied to the keeping of a record of commercial satistics and incidental engineering expenses. The officer in charge considers $600,000 as the least amount which should be available before beginning construction of the jetties. Taking into consideration the balance available ($57,891.41), the sum of $540,000, in round numbers, would be needed to make up the amount named. The officer in charge suggests that, if the importance of the port be not considered sufficient to justify so large an appropriation, the improvement be deferred for the present.

July 1, 1890, balance unexpended	$58,181.41
June 30, 1891, amount expended during fiscal year	290.00
July 1, 1891, balance unexpended	57,891.41
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 to 1867.	1,071,090.23

(See Appendix U 6.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Allen, and reports thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Major Allen, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered.

1. *Mouth of Double Bayou in Chambers County, Texas, to remove obstructions.*—Report transmitted to Congress and printed as House Ex. Doc. No. 117, Fifty-first Congress, second session. (See also Appendix U 7.)

2. *Trinity River, Texas, from its mouth to Dallas.*—Report transmitted to Congress and printed as House Ex. Doc. No. 275, Fifty-first Congress, second session. (See also Appendix U 8.)

3. *Colorado River, Texas, with a view of removing raft at mouth of same.*—Report transmitted to Congress and printed as House Ex. Doc. No. 138, Fifty-first Congress, second session. (See also Appendix U 9.)

4. *Aransas Bay, Texas, to remove Half-Moon Reef.*—(See Appendix U 10.)

5. *St. Charles Bay, Texas, with a view of removing obstructions at mouth of same.*—(See Appendix U 10.)

The required preliminary examination of *West Galveston Bay, Texas, from Christians Point, with a view of reopening the channel through West Bay*, was made by the local engineer in charge, Major Allen, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Major Allen, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Major Allen was charged with its survey, the report on which will be submitted when received.

Major Allen was charged with the required preliminary examination of *Brazos River, Texas, from its mouth to Waco*, and the reports of its results will be submitted when received.

WESTERN RIVERS.

IMPROVEMENT OF CERTAIN RIVERS AND WATER-WAYS IN LOUISIANA, TEXAS, ARKANSAS, MISSISSIPPI, AND TENNESSEE, TRIBUTARY TO MISSISSIPPI RIVER; WATER GAUGES ON MISSISSIPPI RIVER AND ITS PRINCIPAL TRIBUTARIES.

Officer in charge, Capt. J. H. Willard, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Red River, Louisiana and Arkansas.*—This improvement was begun in 1828, and appropriations aggregating $535,765.50 were made between 1828 and 1852. Between 1841 and 1852 no appropriation was made, and a longer interval elapsed between 1852 and 1872, during which period the results of former work were lost.

The present improvement, from Fulton, Ark., to Atchafalaya, commenced in 1872, at which time navigation above Shreveport, La., was almost impossible on account of the great raft. The falls at Alexandria were impassable at low stages. Navigation below Shreveport to Grand Ecore was affected seriously by the gradual enlargement of Tone Bayou Outlet, which depleted the main channel; and the entire river was obstructed by snags, sunken logs, wrecks, and leaning trees.

The project contemplated the removal of raft, snags, wrecks, leaning timber, etc.; closing Tone Bayou; opening a channel through the falls at Alexandria, and deepening the channel at sand bars. Also protection of caving banks at Alexandria. Owing to the nature of the work it must be continuous for many years, and no estimate of cost was made on this account.

The amount expended to June 30, 1890, was $888,783.69 (including liabilities $20.02), resulting in great benefit to navigation. A channel was opened through the great raft in 1873, and operations since, aided by the current, have secured an enlarged channel-way with greater depth everywhere, continually widening and scouring, and but little water is diverted from the river proper at ordinary stages. The work of removing obstructions and clearing the banks and prompt removal of jams has prevented new formations of raft. No work has been done at Tone Bayou since 1882, when the dam under construction was destroyed. This outlet is filling up gradually with drift, and this, in connection with the work in the old raft region above, is causing the main channel to widen and scour. The rock excavation and dam at the falls of Alexandria were completed in 1885, increasing the period of navigation about 2 months, and as a general thing permitting boats to pass the falls the year round. The dam and training wall, built at Alexandria in 1884–'85 for protecting the caving bank, accomplished the purpose for which intended. The removal of snags and clearing the banks for the general improvement of the river were not begun until 1878, but since 1885 operations have been confined to that class of work. The survey of Red River was carried from Fulton, Ark., to Grand Bend, La., near Alexandria, a distance of 406 miles. Under the act of 1888, work was extended into Cypress Bayou and Bayou Dorcheat, tributaries of Red River.

In the past fiscal year a large steam snag boat and a small hand-propelled snag boat continued removing obstructions whenever the stage of water would permit. The work of these boats was of great benefit to navigation, and no vessel was lost in the river during the year, and no serious accident reported. Boats from New Orleans ran

through to Shreveport on regular time when the gauge at the latter place read only 2 feet, a condition previously unknown.

With the exception of discharge and sediment observations between Shreveport and Alexandria, and level connections with high-water marks, field work of the survey has not been resumed. Work upon the maps was continued during the year.

The allotments by the act of 1890 for work at Alexandria, closing Sale and Murphy Outlet, and widening and deepening the "Little River" below Scopini Cut-off have not been used, with the exception of the amounts required to examine the outlet and to make a reconnoissance and survey of the stretch of river from Scopini Cut-off to Knox Point.

The amounts expended during the past year were:

For general improvement	$29,346.36
For Cypress Bayou, etc	285.94
For examination of Sale and Murphy Outlet	101.20
For examination and survey of Little River from Scopini Cut-off to Knox Point	2,323.99
For survey of Red River	4,773.90
Total	36,831.39

The estimates for the fiscal year 1893 are·

For general improvement, repairs, and additions and care of plant	$81,000.00
Repairing and enlarging levees to confine the river to the adopted channel, thereby improving and giving ease and safety to navigation	158,000.00
Closing outlets	50,000.00
Establishing and maintaining gauges	3,000.00
Completing survey of river	97,000.00
Local surveys and examinations of caving banks for revetment works, etc.	3,500.00
Administration	7,500.00
Total	400,000.00

Red River frequently is jammed in a few hours with acres of drift, and raft formation is prevented only by prompt service of snag boats. Should jams occur when funds are exhausted it is probable that new rafts would form, diverting the river from the bed upon which thousands of dollars have been spent to lose itself in the low lands and bayous, destroying by the way a fertile country that has been reclaimed from overflow by the improvement and the construction of levees by the State of Louisiana. In view of the above it is recommended that a permanent appropriation be provided for the purpose of securing the uninterrupted work of operating the snag boats, not to exceed in the aggregate for each year the sum of $25,000.

July 1, 1890, balance unexpended	$13,236.33
Amount appropriated by act approved September 19, 1890	128,000.00
	141,236.33
June 30, 1891, amount expended during fiscal year	36,831.39
July 1, 1891, balance unexpended	104,404.94
July 1, 1891, outstanding liabilities	429.46
July 1, 1891, balance available	103,975.48
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	400,000.00

(See Appendix V 1.)

2. *Red River above Fulton, Arkansas.*—In charge of Capt. H. S. Taber, Corps of Engineers, to November 24, 1890. The project for this

improvement, adopted in 1886, contemplated removing snags, drift, overhanging trees, etc., above Fulton to the mouth of Kiamichi River, 138 miles, to give reasonably safe navigation at high and medium stages.

The amount expended to June 30, 1890, was $10,000, with which a a small hand-propelled snag boat was built in the fiscal year 1887, at a cost of $4,000, and employed during the succeeding two years in removing obstructions.

In the past fiscal year the snag boat was sold, to the work of improving Red River, Louisiana and Arkansas, for $1,500, and the proceeds, with the appropriation by act of 1890, $2,000, were applied to continuing the removal of snags, drift, and leaning trees. This work practically completed the project, and has been commended by the steamboat men.

Unless a single appropriation of $10,000 can be granted to allow the systematic clearing of the banks and channel without interruption, no further work is recommended for the present. This amount can be expended economically, and would clear the banks of caving and sliding trees and stop accumulations of drift, and by the removal of logs from the channel permit the bottom to scour and give better navigation. Such work would benefit navigation below Fulton also, as there would be less drift to contend with.

Amount appropriated by act approved September 19, 1890	$2,000.00
Amount received from sale of snag boat *Breck*	1,500.00
	3,500.00
June 30, 1891, amount expended during fiscal year	3,273.82
July 1, 1891, balance unexpended	226.18
July 1, 1891, outstanding liabilities	1.07
July 1, 1891, balance available	225.11
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix V 2.)

3. *Ouachita and Black rivers, Arkansas and Louisiana.*—The improvement of Ouachita River commenced in 1871. Black River, the connecting stream between Ouachita and Red Rivers, was added under the same head of appropriation by the act of 1884. The original project contemplated improvement by a system of locks and dams, but was abandoned in 1874 on account of its cost as compared with the commerce then reported. The present project contemplates removing snags, logs, wrecks, leaning timber, etc., and the improvement of shoal places between Camden, Ark., and the mouth of Black River, 341 miles. No estimate of cost is given, as the nature of the work requires that it be continuous.

The total amount expended to June 30, 1890, was $320,325.11, of which $206,737.24 was applied to operations under the present project. The work consisted principally of removing snags and logs and tree slides from the channel and cutting leaning timber. An increased depth was gained at some of the shoals by stone and brush dams.

In the past fiscal year a small snag boat was employed in removing obstructions, principally tree slides, between the mouth of Black River and Monroe, La., 174 miles above, from October 12 to November 17, operations having been stopped on the latter date by high water. June 12 a large snag boat was sent into Black River and worked up to Rock

Row, 17 miles above Monroe, and was still employed in the lower river at the end of the year. A chopping party commenced work at Camden November 5 and at the end of the year had carried operations downstream 32 miles. Work with this party was suspended from January 1 to June 1 by high water.

A survey of Catahoula Shoals, 67 miles above the mouth of Black River, which obstruct navigation greatly at low stages, was made in August. A project for the work needed is submitted by the officer in charge, with an estimate of $20,000, and it is recommended that the entire amount be granted in one appropriation, in order that the work may be prosecuted economically and without delay.

The sum of $40,000 can be expended to advantage of commerce and navigation in the fiscal year 1893, in continuing operations for the general improvement of the river from Camden to mouth of Black River, exclusive of the work at Catahoula Shoals.

Since the project for improvement by locks and dams was abandoned, three examinations have been ordered and made with a view to slackwater navigation, the last in 1889, and the reports on all agree that for the present work should continue under the adopted project. A thorough survey of the valley of the Ouachita and tributaries is recommended, however, to obtain all information necessary for future improvement. It will take about 2½ years to complete such a survey, and its estimated cost is $150,000 if available in one appropriation, so that the work can be done without delay.

July 1, 1890, balance unexpended	$7,174.89
Amount appropriated by act approved September 19, 1890	15,000.00
	22,174.89
June 30, 1891, amount expended during fiscal year	9,398.34
July 1, 1891, balance unexpended	12,776.55
July 1, 1891, outstanding liabilities	241.67
July 1, 1891, balance available	12,534.88

Amount that can be profitably expended in fiscal year ending June 30, 1893, and for completion of survey $210,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix V 3.)

4. *Ouachita River above Camden, Arkansas.*—The project for this improvement contemplated removing snags and leaning timber, and building brush dams at the shoals, to afford navigation at high stages between Camden and Arkadelphia, Ark., at an estimated cost of $9,000.

The act of 1888 appropriated $9,000 to complete the work.

The sum of $6,599.26 was expended in the fiscal year 1890, carrying operations from Arkadelphia down to Camden, and resulting in the removal of the worst obstructions.

The balance of the appropriation was used in the past fiscal year in going over the work, which was completed in November, 1890, giving reasonably safe navigation at stages high enough for boats to pass the shoals. Dredging these shoals would not benefit navigation, and, as there is no commerce at all commensurate with the cost of further improvement, no further estimate is made.

July 1, 1890, balance unexpended	$2,400.74
June 30, 1891, amount expended during fiscal year	2,400.74

(See Appendix V 4.)

5. *Bayou D'Arbonne, Louisiana.*—The project for this improvement was adopted in 1884, and contemplates removing snags, logs, wrecks, leaning timber, etc., obstructing navigation from Stein Bluff, on the Corney Branch, to the mouth of D'Arbonne, 42½ miles, at an estimated cost of $15,000.

The amount expended to June 30, 1890, was $9,000. Before the improvement commenced the bayou was navigable from 6 to 7 months of the year. The work done extended the period of navigation fully one month, enabled boats of double the capacity to make quicker time than those used formerly and at less risk, and reduced freight rates one-half.

In the past fiscal year operations were commenced the latter part of December, but had to be stopped the middle of January on account of high water, and, as there was no prospect of being able to resume work until late in the summer, the boat was transferred to Bayou Bartholomew in May.

The work is not permanent, as new obstructions are added from time to time, but it can be done so thoroughly as not to require attention for several years if the balance of the original estimate is granted in one appropriation.

Amount appropriated by act approved September 19, 1890	$2,000.00
June 30, 1891, amount expended during fiscal year	1,109.49
July 1, 1891, balance unexpended	890.51
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be expended profitably in fiscal year ending June 30, 1893	4,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix V 5.)

6. *Bayou Bartholomew, Louisiana and Arkansas.*—This improvement was begun in 1881, the project contemplating the removal of snags, logs, wrecks, leaning timber, etc., obstructing navigation between Baxter, Ark., and the mouth, about 150 miles.

The amount expended to June 30, 1890, was $27,995.10.

Before the work commenced the average duration of the navigable season was 3 months. In 1890 it was reported that there was better navigation for 6 months, that boats of double the capacity made trips with greater safety in half the time, and that the rates of freight had been reduced 50 per cent.

In the past fiscal year work was commenced at Portland, Ark., May 11, and continued till the end of the year. Operations extended over about 50 miles of the stream, and were so thorough that boats will be enabled to navigate this stretch on from 3 to 4 feet less water, with greater safety, and make better time.

New obstructions are added from time to time, but if sufficient appropriation is made to clear the obstructions thoroughly the cost of maintaining navigation will be slight.

July 1, 1890, balance unexpended	$4.90
Amount appropriated by act approved September 19, 1890	5,000.00
	5,004.90
June 30, 1891, amount expended during fiscal year	2,758.34
July 1, 1891, balance unexpended	2,246.56
July 1, 1891, outstanding liabilities	347.60
July 1, 1891, balance available	1,898.96

Amount that can be profitably expended in fiscal year ending June 30, 1893	$10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 6.)

7. *Bayou Bœuf (Bœuf River), Louisiana.*—The project for improving this bayou was adopted in 1881, and contemplated removing snags, logs, leaning timber, etc., obstructing navigation between Wallace Landing and the mouth, about 152 miles. Three outlets near Point Jefferson, La., were examined in 1884 and their closure recommended.

The amount expended to June 30, 1890, was $25,977.91. The removal of obstructions enabled steamboats to run to Point Jefferson, 19 miles below Wallace, during high stages, with greater safety. The three outlets were closed in 1887 and 1888, but the dams were destroyed during the overflow from the Mississippi River in the spring of 1890. It is essential that they be rebuilt to maintain navigation in the bayou; the estimated cost of this work is $12,000.

Nothing was done during the fiscal year 1891, on account of high water.

July 1, 1890, balance unexpended	$22.09
Amount appropriated by act approved September 19, 1890	5,000.00
	5,022.09
June 30, 1891, amount expended during fiscal year	50.77
July 1, 1891, balance unexpended	4,971.32
July 1, 1891, outstanding liabilities	22.00
July 1, 1891, balance available	4,949.32

Amount that can be profitably expended in fiscal year ending June 30, 1893	26,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 7.)

8. *Tensas River and Bayou Maçon, Louisiana.*—The project for improving Tensas River was adopted in 1881, and contemplated removing snags, logs, and leaning timber obstructing navigation between Dallas and its mouth, about 134 miles, at an estimated cost of $23,000. Bayou Maçon, a tributary, was added under the same head of appropriation by act of 1884, and the project contemplated removing the same class of obstructions between Floyd and its mouth, about 98 miles, at an estimated cost of $17,000.

The amount expended to June 30, 1890, was $15,873.24, of which $7,529.25 had been applied to the Tensas and $8,343.99 to the Maçon. The obstructions were removed as far as practicable with these amounts, and in Bayou Maçon, the principal commercial branch, had resulted in improved navigation so as to shorten the time of steamboat trips 12 hours.

Owing to high stages of water during the greater portion of the period since the act of 1890, no work was done during the past fiscal year.

July 1, 1890, balance unexpended	$126.76
Amount appropriated by act approved September 19, 1890	5,000.00
July 1, 1891, balance unexpended	5,126.76
July 1, 1891, outstanding liabilities	.28
July 1, 1891, balance available	5,126.48

Amount (estimated) required for completion of existing project	$19,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 8.)

9. *Bayous Rondeway and Vidal, Louisiana.*—An appropriation of $1,000 was expended in the fiscal year 1889 in removing obstructions, chiefly leaning trees, from the canal and the part of Bayou Vidal remaining open between Lake Palmyra (an old bend of the Mississippi) and the line of levee north of the lake. After completion of this work, the canal was claimed as private property and the owner issued notice that tolls would be collected from passing boats, and for this reason it was recommended that the old mouth of the bayou, which was obstructed by leaning timber and fallen timber and stumps, be reopened, to save the steamboat interest from such imposition.

The act of 1890 appropriated $1,000 for this purpose, but owing to high stages of the Mississippi the work was not begun until the latter part of June, when a chopping party commenced operations.

Amount appropriated by act approved September 19, 1890	$1,000.00
June 30, 1891, amount expended during fiscal year	116.02
July 1, 1891, balance unexpended	883.98
July 1, 1891, outstanding liabilities	.69
July 1, 1891, balance available	883.29

(See Appendix V 9.)

10. *Big Black River, Mississippi.*—The original project for this improvement contemplated removing snags, logs, leaning timber, etc., obstructing navigation between Cox Ferry and the mouth, about 130 miles, at an estimated cost of $32,000.

The first appropriation, by act of 1884, $5,000, was applied to removing the principal obstructions for a distance of 75 miles above the mouth.

The next appropriation, by act of 1886, contained the proviso that no part of the appropriation should be used until the State of Mississippi caused the bridges below the Vicksburg and Meridian Railroad to be so constructed as not to obstruct navigation. But one of the bridges now obstructs navigation, located about 20 miles below the railroad, and called the Baldwin Ferry Bridge.

The act of 1890 removed the restriction contained in the act of 1886, and the project was modified to include only the portion of the river below the Baldwin Bridge. Work was commenced in January, 1891, and continued, whenever the stages of water were favorable, until June 18. The principal work done was between Baldwin and Ivanhoe ferries, a distance of about 20 miles. It will require about $10,000 to clear the lower part of this river thoroughly, and until this amount can be granted in a single appropriation nothing further should be done, as smaller appropriations can not be expended with economy.

July 1, 1890, balance unexpended	$5,000.00
June 30, 1891, amount expended during fiscal year	4,735.23
July 1, 1891, balance unexpended	264.77
July 1, 1891, outstanding liabilities	20.96
July 1, 1891, balance available	243.81

Amount (estimated) required for completion of existing project.....	$10,000.00
Amount that can be profitably expended in fiscal year ending June 30,1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 10.)

11. *Yazoo River, Mississippi.*—Work in this river was begun in 1873. The project contemplates removing snags, logs, wrecks, and leaning timber obstructing navigation throughout the entire length of the stream. New obstructions are brought into the river every year by floods, sliding banks, etc., and no estimates for permanent improvement have been made on this account.

The amount expended to June 30, 1890, was $186,875.13. Prior to improvement the river was obstructed by a large number of wrecks, and by snags and leaning timber. Nine of the steamboats sunk during the war were removed by contract in 1873–'74, and snag boats have operated since whenever funds were available, benefiting low-water navigation greatly, and keeping the river in navigable condition from head to mouth the year round.

In the past fiscal year a snag boat was employed in removing obstructions October 20 to 31, during the month of December, and June 2 to 15 and 21 to 25, and did effective work.

The shifting bar at the mouth of the river is the most serious obstruction to navigation. Boats that could navigate the principal streams of the Yazoo Valley system (about 800 miles) without hindrance are prevented at low stages from entering or leaving without lightening, and at times navigation across the bar is stopped altogether. The item of appropriation for this river by act of 1890 contained an allotment of $5,000 to be used in making a survey from the Louisville, New Orleans, and Texas Railway bridge to the mouth, to determine in what manner the mouth can be improved to permit free passage of vessels at all seasons of the year, and to include an investigation of the feasibility and advantage of making a new outlet for the river by way of Chickasaw Bayou, or otherwise, with an estimate of cost. This survey was begun in October and continued until high water compelled suspension, December 6, and the river remained too high until the end of the fiscal year to complete field work. The maps are finished, except the last sheet.

The cost of the survey required the full amount of the allotment, and if it should appear feasible to divert the river through a new outlet, it will be important to make borings along prospective lines. The estimated cost of this work is $2,500, which is included in the amount asked for the fiscal year 1893.

July 1, 1890, balance unexpended.....		$3,124.87
Amount appropriated by act approved September 19, 1890.....		25,000.00
		28,124.87
June 30, 1891, amount expended during fiscal year		14,780.90
July 1, 1891, balance unexpended		13,343.97
July 1, 1891, outstanding liabilities.....		23.69
July 1, 1891, balance available		13,320.28
Amount that can be profitably expended in fiscal year ending June 30,1893		40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix V 11.)

12. *Tchula Lake, Mississippi.*—This work was commenced in 1881, and the project contemplates removing snags, logs, leaning timber, etc., obstructing navigation, to permit light-draught boats to enter the lake earlier in the season.

The amount expended to June 30, 1890, was $10,278.57.

In the past fiscal year a snag boat worked for 10 days in December removing snags, tree slides, etc., from the channel, and the balance available is to be applied to clearing the banks at low water.

The work is of such nature that it must be gone over to remove obstructions added from time to time, but by an expenditure of $6,000 in one low-water season it can be done so thoroughly that nothing should be required for several years.

July 1, 1890, balance unexpended	$1,721.43
Amount appropriated by act approved September 19, 1890	3,000.00
	4,721.43
June 30, 1891, amount expended during fiscal year	1,135.20
July 1, 1891, balance unexpended	3,586.23
Amount (estimated) required for completion of existing project	6,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 12.)

13. *Tallahatchee River, Mississippi.*—This improvement was begun in 1879, and contemplated removing snags, sunken logs, and leaning timber, obstructing low-water navigation below the mouth of Coldwater River about 100 miles, and the removal of a wreck in the channel near the mouth. The estimated cost was $40,000, if completed in two seasons.

The amount expended to June 30, 1890, was $32,500, of which $10,000 were expended above the mouth of Coldwater (a part of the river not included in the project), in accordance with the provisions of the appropriations. The balance was spent between the mouth of Tallahatchee and Sharkey Landing, about 65 miles above, to the great benefit of navigation. Before the improvement commenced the river was navigable about 6 months of the year. Now boats run to Sharkey the year round.

In the past fiscal year work was retarded by high water, but a snag boat was employed for 5 weeks, in November and June, and extended operations about 25 miles above Sharkey.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	2,968.98
July 1, 1891, balance unexpended	2,031.02
Amount (estimated) required for completion of existing project	12,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 13.)

14. *Steele's Bayou and Washington Bayou, Mississippi.*—Work in this stream commenced in 1884. The project contemplates removing snags, stumps, drift, and leaning timber, to improve high-water navigation.

The amount expended to June 30, 1890, for this purpose was $7,500, and operations extended over the navigable part of the bayou, but there were not sufficient funds to do the work thoroughly.

A snag boat was employed for three weeks in February, 1891, in removing obstructions from the lower 50 miles of the bayou until stopped by high water.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	1 520.66
July 1, 1891, balance unexpended	979.34
July 1, 1891, outstanding liabilities	.31
July 1, 1891, balance available	979.03
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix V 14.)

15. *Big Sunflower River, Mississippi.*—Work in this river commenced in 1879. The project contemplated building wing dams to scour a channel from 3 feet to 40 inches deep at the bars, and the removal of snags, sunken logs, and leaning timber obstructing navigation. The cost was estimated at $66,000, if the work should be completed in three or four consecutive seasons.

The amount expended to June 30, 1890, was $52,000. Operations during the 12 years extended over the navigable part of the river, from Clarksdale to its mouth, but as new obstructions were added every year, and owing to small and irregular appropriations, the work never has been done thoroughly. However, the following benefits were reported: Before the improvement commenced the river was navigable for very light boats about 6 months in the year; now it is navigable the year round, but difficult and dangerous at low stages on account of shoals, snags, and sunken logs. Larger boats are used, and make the round trip (of about 180 miles and return) in 5 days, while before the improvement it was unusual for a boat to make this trip under 8 days. Freight rates are reported to be 50 per cent. less. Of late years the lands along the river are being cleared and settled rapidly, which is attributed partly to improved navigation.

In the past fiscal year a large snag boat was employed in this river from January 10 to February 13, and a smaller snag boat during the month of June. Operations extended up to 18 miles above Faisonia, or about 160 miles above the mouth.

It is recommended that future appropriations shall not restrict expenditures to designated localities, in order that the funds may be applied wherever they will yield the greater benefit to navigation. The amount estimated for can be spent to advantage, and will result in greater benefit to navigation and work of more permanent character than a larger sum by small allotments.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	4,196.07
July 1, 1891, balance unexpended	803.93
July 1, 1891, outstanding liabilities	4.79
July 1, 1891, balance available	799.14
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix V 15.)

16. *Big Hatchee River, Tennessee.*—This work was commenced in 1880. The project contemplates removing logs, snags, leaning timber, etc., obstructing navigation from Bolivar, Tenn., to the mouth, about 240 miles, to render the river navigable for light-draft boats throughout the year.

Before work commenced navigation virtually was suspended by the obstructions. The amount expended to June 30, 1890, was $26,999.19, rendering the stream navigable for light boats for from 7 to 9 months of the year.

High water prevented resuming work during the past fiscal year.

The improvement is not permanent, as new obstructions are added from time to time, but if operations are continued, economy will be subserved by expending in one season an amount sufficient to clear the river so that further work shall not be needed for several years.

July 1, 1890, balance unexpended	$0.81
Amount appropriated by act approved September 19, 1890	5,000.00
July 1, 1891, balance unexpended	5,000.81
July 1, 1891, outstanding liabilities	.48
July 1, 1891, balance available	5,000.33
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix V 16.)

17. *Forked Deer River, Tennessee.*—Work in South Fork of this river commenced in 1883. The act of 1888 added North Fork and main river under the general head of improving Forked Deer River. The project contemplates removing snags, logs, leaning timber, etc., from the main stream, South Fork below Jackson, and North Fork below Dyersburg.

The amount expended to June 30, 1890, was $19,500, of which $12,500 were applied to South Fork, $4,500 to North Fork, and $2,500 to the main river. The two forks were put in fairly good navigable condition, but in the main stream no material benefit was gained.

No work was done in the past fiscal year, on account of high water.

South Fork is obstructed by numerous bridges which render steamboat navigation impracticable, and for the present further improvement is not deemed necessary. With the amount available and an additional appropriation of $3,000, it is believed that work in North Fork and main stream can be completed.

Amount appropriated by act approved September 19, 1890	$2,500.00
July 1, 1891, balance unexpended	2,500.00
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	3,000.00

(See Appendix V 17.)

18. *Water gauges on Mississippi River and its principal tributaries.*—These gauges were established in 1871 under joint resolution of Congress approved February 21, 1871 (Statutes at Large, vol. 16, page 598), for the purpose of securing information from continuous records, with a view to protecting the valley of the Mississippi from overflow, improving navigation, and giving correct reports for the benefit of river men and planters.

The amount expended to June 30, 1890, was $81,952.05. Nineteen gauges were established originally, and, under the portion of the joint resolution of 1871 authorizing gauges "at such other places as the Secretary of War may deem advisable," the following have been added, viz: At Nashville, Tenn., Cumberland River, in 1873; Shreveport, La., Garland, Ark., and Fulton, Ark., Red River, in 1890, and Donaldsonville, La., Mississippi River, in 1890. The gauge at Rock Island, Ill., was abandoned in 1879, and the one at Fort Leavenworth, Kans., in 1886, but a record at the latter place has been maintained by the Missouri River Commission.

There are now 22 gauges maintained under this work, and in addition to the extensions mentioned above, the service has been improved very materially of late years. In 1881 bulletins were erected at the stations on the Mississippi, for the purpose of giving passing steamboats the stage of water and indicating whether the river was rising, stationery, or falling, and in 1890 these were replaced by larger bulletins, and the old ones repaired and used in extending the service to the tributaries. Since February 1, 1887, the gauges have been read and bulletins posted twice a day, to secure greater uniformity and accuracy; formerly they were read only once a day. Records of the readings have been published by the Mississippi River Commission to the end of the calendar year 1890.

Observations commenced at each station as soon as the gauge was set up, and with a few exceptions have been kept up ever since, but owing to small and irregular appropriations, many difficulties were encountered in making the work continuous. In 1878 observations were stopped for want of funds, but many observers continued the records without compensation. In 1884 a deficiency appropriation was made for their continuance. In 1886 the Mississippi River Commission paid the observers and repaired the gauges on the Mississippi to prevent suspensions, and in 1887–'88 the readings were continued voluntarily by the observers.

The value of the records requires that they shall be accurate and continuous, and to provide for this and enlarge and perfect the service a permanent indefinite appropriation was made by section 6 of the river and harbor act of August 11, 1888, to secure uninterrupted gauging. It was understood that this appropriation intended to provide that the amount to be expended for gaugings should not exceed in the aggregate for each year the sum of $9,600, part of which amount should be allotted for gaugings at or near St. Paul, Minn., as required by the closing paragraph of the item of appropriation in the act of August 11, 1888, for continuing operations upon the reservoirs at the headwaters of the Mississippi River. In accordance with this understanding, the officer in charge of gauges on Lower Mississippi and tributaries was authorized to expend $9,000 in the fiscal year 1890, and his project for the expenditure of $8,700 in the fiscal year 1891 was approved. Upon submitting request for funds in April, 1891, it was returned, with the notification that the act of August 11, 1888, allowed only $6,000 to be drawn during each fiscal year, and that amount having been drawn there were no funds available.

As $900 had been allotted for gaugings at St. Paul, such construction of the law allowed but $5,100 for this work, and on this account seventeen of the observers were paid for the last quarter of the fiscal year 1891 from appropriations for works of improvement to which the records were of great value, and thus secured their continuity.

In view of the foregoing, and to provide for the maintenance of the present gauges, a judicious extension of the service, by adding other gauges now on the Mississippi and establishing new ones at such other

places as may be deemed advisable; by gradual level connections with a common reference plane to give the greatest value to the records, and frequent and rigid inspections to prevent errors in the gauges and records, it is recommended that section 6 of the act of August 11, 1888, be amended to grant a permanent appropriation of such amount as may be necessary to do the work, not to exceed in the aggregate for each fiscal year the sum of $12,000.

July 1, 1890, amount available (provided by act of August 11, 1888)		$9,600.00
Amount allotted for gaugings at St. Paul		900.00
Amount authorized to be expended for gauging lower Mississippi and tributaries by approved project		8,700.00
Amount of outstanding liabilities of fiscal year 1890		5.19
July 1, 1890, total amount available		8,705.19
June 30, 1891, amount expended during fiscal year	$4,934.35	
Amount withheld at Treasury United States	3,523.53	
		8,457.88
July 1, 1891, balance unexpended		247.31
July 1, 1891, outstanding liabilities		211.87
July 1, 1891, balance		35.44
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		12,000.00

(See Appendix V 18.)

19. *Survey of Cypress Bayou and the lakes between Jefferson, Texas, and Shreveport, Louisiana.*—This survey was ordered by the act of September 19, 1890—

to ascertain if the navigation of said bayou and lakes can be materially and permanently improved by the construction of such dams and locks and dams as may be necessary, and, if found practicable, the probable cost thereof.

The approved project contemplated beginning on the Red River survey at the Shreveport base, crossing the country to the lakes, and then along the hills to Jefferson; precise levels from Shreveport to Jefferson, and search for benches of early surveys to compare the changes since the Red River Raft was removed; examination of outlets to Red River; topography, to include transit and stadia work, banks, lines of bayous and lakes, etc., to determine drainage; and soundings and discharge observations and borings at possible sites of construction.

At the end of the fiscal year field work had been completed, though operations were impeded and the cost of the survey increased by high water. The maps are being laid out, and effort will be made to complete them at an early date.

Borings were not made, as the water was too high and the funds available are not sufficient for the purpose. The original estimates for this work amounted to $12,000, and it is recommended that the balance, $2,000, be appropriated to make the borings at low water.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		9,897.99
July 1, 1891, balance unexpended		102.01
July 1, 1891, outstanding liabilities		3.84
July 1, 1891, balance available		98.17

Amount (estimated) required for completion of existing project.....	$2,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V 19.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1891.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Willard, and reports thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Willard, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Cane River, Louisiana, with a view of improving the same by locks and dams for the purpose of giving permanent navigation the year round.*—Printed as House Ex. Doc. No. 184. (See also Appendix V 20.)

2. *Bayou Castor, Louisiana.*—Printed as House Ex. Doc. No. 185. (See also Appendix V 21.)

IMPROVEMENT OF ARKANSAS RIVER, ARKANSAS, INDIAN TERRITORY, AND KANSAS, AND OF CERTAIN RIVERS IN ARKANSAS AND MISSOURI.

Officer in charge, Capt. H. S. Taber, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Removing obstructions in Arkansas River, Arkansas, Indian Territory, and Kansas.*—Prior to the first improvements in 1833 shifting sand bars, numerous drift piles, and dangerous snags constituted the obstacles to navigation in the lower reaches, and gravel and rock shoals, with a few snags and many overhanging trees, constituted those of the upper. Except for a few special reaches, like the Fort Smith and Pine Bluff, the general plan of improvement has consisted in snagging operations, including the cutting of overhanging trees, in building wing dams to improve the shoals, and in surveys looking towards plans for its permanent improvement.

The appropriations to June 30, 1891, amount to $485,251.37. Of this sum there had been expended to June 30, 1890, $391,288.67.

During the fiscal year ending June 30, 1891, $9,330.43 were expended in snagging operations at or near low water. The unusually well maintained high water of this year has prevented very extensive operations. Two light-draft snag boats are required similar to the one now in use to take advantage of the low-water season. With $70,000 in hand July 1, 1892, an effective clearance of the Arkansas River could be secured. After that the two snag boats could be utilized as towboats upon the work of "Improving Arkansas River, Arkansas, Indian Territory, and Kansas," being used for snagging purposes whenever necessary. It would be advantageous and economical if in future the appropriations for snagging and for the permanent improvement of the river could be made under one head, and a specific sum set apart for snagging, if deemed best.

July 1, 1890, balance unexpended	$1,674.89
Amount appropriated by act approved September 19, 1890	20,000.00
	21,674.89
June 30, 1891, amount expended during fiscal year	9,330.43
July 1, 1891, balance unexpended	12,344.46
July 1, 1891, outstanding liabilities	1,227.55
July 1, 1891, balance available	11,116.91
Amount that can be profitably expended in fiscal year ending June 30, 1893	70,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W 1.)

2. *Arkansaε River, Arkansas, Indian Territory, and Kansas.*—Work during the past season has been carried on under three different acts of Congress. By the act approved August 5, 1886, $75,000 was appropriated, its distribution being indicated in the following words: Improving Arkansas River, Arkansas: Continuing improvement, $75,000, according to the plan and recommendations in Appendix V 13, Report of Chief of Engineers, 1885, pages 1601 to 1611, of which there are to be expended $8,000 at Pine Bluff, $13,000 at Fort Smith, and $10,000 at Dardanelle or so much thereof under those sums, respectively, as may be necessary at those points.

This appropriation, except a small sum out of the $10,000 for Dardanelle, was expended prior to June 30, 1890; at Dardanelle the $10,000 was to be expended in erecting a permeable dike above and opposite the town, in such a position as to remove the sand bar in front of the wharves. By act of August 11, 1888, the sum of $150,000 was appropriated for improvement of this river, under plan providing for the formation of a channel at least 200 feet wide and 6 feet deep at low water, from Little Rock to the Mississippi River; and the formation of a channel 2 feet deep at low water and from 200 to 800 feet wide from Fort Gibson to Arkansas City, as contemplated in the report of the Chief of Engineers for the year ending June 30, 1885, and in House Ex. Doc. No. 90, Forty-ninth Congress, first session, and authorized in the act approved August 5, 1886.

By act approved September 19, 1890, the sum of $180,000 was appropriated, its distribution being indicated as follows:

> Improving Arkansas River, Arkansas, Indian Territory, and Kansas: Continuing improvement from Wichita, Kansas, to its mouth, one hundred and eighty thousand dollars.

The approved projects for the expenditure of this sum may be summarized as follows: At Pine Bluff $8,000 is to be used in extending and repairing the dikes, for protection of the town front. At Van Buren $4,000, to be expended in erecting a permeable dike at a suitable point a little above the town and upon the opposite side of the river, to contract the channel and prevent it from leaving the city wharves. From Fort Gibson, Ind. T., to the mouth of the river, the balance to be expended in the erection of permeable dikes and in rock excavation at worst places, so far as the amount of the appropriation will permit, looking towards the permanent improvement of the river, to give a channel at least 6 feet deep and 200 feet wide from Little Rock to the mouth of the river, via White River Cut off, as provided under the act of August 5, 1886, and an all-year-round depth of water of at least 2 feet from Little Rock, Ark., to Fort Gibson, Ind. T.

Before operations were begun at Dardanelle a bad bar had formed

along the town front, cutting off all approach to either wharf at low water or at medium stage. At Pine Bluff, before improvement, a cut-off was threatened at one point, which would change the slope of the river from three-fourths of a foot to 4 feet per mile; at another point a bad bar interfered with navigation at low water; and in the sharp bend in front of the town the river was eroding the banks with a rapidity that threatened the town. (See Annual Report, Chief of Engineers, 1887, page 1515.)

From Fort Gibson to the mouth of the river the river consists of alternating bars and caving banks, with crossings more or less troublesome at low water, a few of the latter operating to effectually close the river to navigation at extreme low water for even boats drawing but 2 feet of water.

During the fiscal year ending June 30, 1891, $2,116.60 was expended at Pine Bluff out of the 1888 appropriation, in conjunction with the 1890 appropriation, in extending Dike No. 2 and repairing Dikes 3 and 4.

From Fort Gibson, Ind. T., to the mouth of the river, $94,201.01 has been expended.

There were erected two dikes just above Fort Smith, each 400 feet long, and two dikes, 30 miles above Fort Smith, were well advanced towards completion. Five dikes, aggregating 3,057 feet in length, were erected below Pine Bluff. Ten new barges were built, and additions made to the machinery, and some work done at excavation at Moore's Rocks.

July 1, 1890, balance unexpended	$71,295.42
Amount appropriated by act approved September 19, 1890	180,000.00
	251,295.42
June 30, 1891, amount expended during the fiscal year	94,194.61
July 1, 1891, balance unexpended	157,100.81
July 1, 1891, outstanding liabilities	3,774.80
July 1, 1891, balance available	153,326.01
Amount (estimated) required for completion of existing project	3,472,479.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W 2.)

3. *Fourche River, Arkansas.*—The improvement of this stream was begun in 1879, under the act approved March 3, 1879.

Prior to any improvement its channel was choked with snags, logs, and drift, and heavy timber overhung its banks. Several bad shoals also impeded navigation. Up to June 30, 1886, $21,000 had been expended in removing the greater part of the obstructions. By act approved August 5, 1886, $5,000 was appropriated for removing rock shoals, situated about 4 miles below Perryville. At the close of the fiscal year ending June 30, 1888, this sum had been expended, completing a channel about 500 yards long, 30 feet wide, and 2 feet deep, at low water through this shoal.

By act approved September 19, 1890, $7,500 was appropriated. The approved project for its expenditure provides for the building and equipping of a hand-propelled snag boat, at a cost not to exceed $4,000, to be operated for 4 months at, or near, extreme low water, in removing accumulated obstructions, snags, logs, drift piles, land slides, and

bowlders on Piney Shoals, $450 to be expended in making a cut through May Shoal, to provide for high and medium stage navigation.

During the fiscal year ending June 30, 1891, $2,448.70 was expended in building and equipping the hand-propelled snag boat *Pioneer*. After the boat was completed, high water prevented its use during the balance of the year. As early in the next fiscal year as the water will permit, the boat will be operated, removing logs, snags, and overhanging timber.

The present appropriation will be sufficient to meet present needs of the river.

Amount appropriated by act approved September 19,1890	$7,500.00
June 30, 1891, amount expended during fiscal year	2,448.70
July 1, 1891, balance unexpended	5,051.30
July 1, 1891, outstanding liabilities	330.28
July 1, 1891, balance available	4,721.02

(See Appendix W 3.)

4. *Petit Jean River, Arkansas.*—Before improvement, this river was obstructed by snags, logs, masses of drift wood, overhanging trees, and shoals. The original project for improvement contemplated rendering it navigable, during high and medium stages of water, up to Danville, Ark., by cutting the overhanging trees and cutting up the snags, logs, and drift. Three thousand five hundred dollars was expended in the execution of this project to June 30, 1888. The appropriation made by act of August 11, 1888, was $2,500, and work was limited to the river below the bridge at Rocky Crossing. The new project provides for removing portions of the shoals known as Slaty Crossing and Robinson's Ridge, and certain timber from the low-water channel.

During the fiscal year ending June 30, 1890, no work was done, on account of continued high water rendering it impossible to begin the work with any certainty of completing it.

The fiscal year ending June 30, 1891, was a favorable season for this work, and many obstrctions to navigation were removed. The river still needs improvement, as contemplated in the original project, above the bridge at Rocky Crossing.

July 1, 1890, balance unexpended	$2,444.52
June 30, 1891, amount expended during fiscal year	2,444.52
Amount (estimated) required for completion of existing project	3,500.00
Amount that can be profitably expended in fiscal year ending June 30,1893	3,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W 4.)

5. *White River, Arkansas.*—Before improvement the channel of this river was choked with drift piles, logs, and snags, in its lower portion, and, from Batesville up, gravel bars, rocky shoals, channel bowlders, and overhanging trees impeded navigation. The original project consisted in snagging operations, blasting ledges and bowlders, and dam building to remove gravel bars or to close chutes. The first separate appropriation for this river was made by act approved July 5, 1884. Provision for a survey of the river from Forsyth, Mo., to its mouth, was added to the original project. At that date the river was in excellent navigable condition, for boats drawing not to exceed 3 feet of water, from its mouth to Newport, Ark. From Newport to Batesville there

were many troublesome snags, and from Batesville to Buffalo Shoals there were numerous bad shoals, rendering navigation very uncertain. From Buffalo Shoals to Forsyth, Mo., there were many fine reaches of river, but the depth of water on Buffalo Shoals, and others, prevented any navigation at ordinary stages of water; $77,010.85 had been expended up to June 30, 1890, and this completed the survey, plotted the notes, published the maps, effectively improved the most dangerous shoals between Buffalo Shoals, and removed the most dangerous snags from Buffalo Shoals to the mouth, partially erected a dike at Newport, and secured the material for the erection of dikes below Newport.

The present plan, based on the survey, provides for the maintenance, at low water, of a channel 2 feet deep between Newport and Buffalo Shoals, and a channel of not less than 5 feet deep, at low water, from Newport to the mouth, and also for a limited amount of snagging operations while these improvements are in progress.

The result between Newport and Buffalo Shoals is to be accomplished by the erection of solid wing dams and some rock excavation. From Newport to the mouth this result is to be accomplished by the erection of low, permeable spur dikes, to give the necessary depth of water on the shoals. During the fiscal year ending June 30, 1891, $16,506.39 were expended in the work of improvement, beginning at a point known as Mount Olive, about 47 miles above Batesville, and extending to the town of Batesville, Ark., and in the completion of a spur-dike at Newport, Ark. Much relief has been afforded navigation.

July 1, 1890, balance unexpended	$1,532.26
Amount appropriated by act approved September 19, 1890	30,000.00
	31,532.26
June 30, 1891, amount expended during fiscal year	16,505.85
July 1, 1891, balance unexpended	15,026.41
July 1, 1891, outstanding liabilities	1,525.50
July 1, 1891, balance available	13,500.91

Amount (estimated) required for completion of existing project	153,815.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	153,815.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 5.)

6. *Cache River, Arkansas.*—The first appropriation made for this reach of river became available August 11, 1888. Prior to this time the river was choked with logs, snags, and overhanging trees, and several shoals interfered with low-water navigation. The project proposes the removal of these obstructions from the town of Riverside, Ark., to the mouth of the river. Up to June 30, 1890, $6,992.89 had been expended carrying out the project. The obstructions encountered were more formidable than was expected, and there are some 35 miles of river yet to be worked over.

During the fiscal year ending June 30, 1891, the small balance of $7.11 was expended in caring for the property and records. Three thousand dollars will be required to complete the project.

July 1, 1890, balance unexpended	$7.11
June 30, 1891, amount expended during fiscal year	7.11

Amount (estimated) required for completion of existing project	$3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W 6.)

7. *Little Red River, Arkansas.*—The only improvements ever attempted upon this river were made in 1872. Prior to this work many overhanging trees and a large number of snags interfered with navigation in the lower reaches, and many bowlders obstructed flatboat and raft navigation in the reach above the present town of Judsonia. Most of the overhanging trees and snags were removed as high as Judsonia, and the bowlders remained untouched to the end of June 30, 1886.

By acts of August 5, 1886, and August 11, 1888, $8,400 was appropriated for removing the bowlders above Judsonia and dredging a channel through the shoals 3 miles below. Of this sum $7,153.33 had been expended to June 30, 1890, removing the bowlders, building a dredge and barges, partial excavation of channel, and caring for property.

Under special project overhanging timber and a few logs and snags were removed between the towns of Judsonia and Heber, Ark., and above.

The present appropriation will complete the present project.

July 1, 1890, balance unexpended		$537.86
Received by sale of dredge boat, as per letter of Chief of Engineers, dated August 19, 1890		3,500.00
		4,037.86
June 30, 1891, amount expended during fiscal year		2,140.92
July 1, 1891, balance unexpended		1,896.94
July 1, 1891, outstanding liabilities		75.00
July 1, 1891, balance available		1,821.94

(See Appendix W 7.)

8. *Black River, Arkansas and Missouri.*—This river, before any improvements were made upon it, was practically closed to navigation by means of snags, logs, and overhanging trees, the snags and logs in many places forming shoals, and in other places rock and gravel shoals opposed to navigation. The original plan for improvement contemplated the removal of the obstructions and the improvement of the shoals by wing dams.

A few of the sloughs were to be closed up, so as to confine the water to the main channel. Up to June 30, 1890, $61,242.40 had been expended for this purpose, doing thorough work up to a few miles above the mouth of Current River, and from Poplar Bluff, Mo., to Corning, Ark., and just taking up the worst obstructions to get the snagboat through the balance of the distance. Much work was left undone between Poplar Bluff, Mo., and the Arkansas State line.

During the fiscal year ending June 30, 1891, $1,537.28 was expended in the necessary repairs to the plant and care of property, as there was no boat available for the work after the appropriation was made until the water became too high for effective work. Early in the next fiscal year work will be done between Corning, Ark., and the mouth of Current River. A single appropriation of $42,000 would effectively open up this river, which would need very little attention for its maintenance.

A new hull, to cost $8,000, will be required for the snagboat *Henry Sheldon*, belonging to this river. This is included in the estimate of $42,000.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	1,537.28
July 1, 1891, balance unexpended	3,462.72
July 1, 1891, outstanding liabilities	177.25
July 1, 1891, balance available	3,285.47
Amount (estimated) required for completion of existing project	42,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	42,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W 8.)

9. *Black River, Missouri.*—The first improvements attempted upon this reach of river were made in the years of 1881 and 1882. Prior to this work its channel was choked with snags and logs and obstructed by overhanging trees, and in many places shoals interfered with its navigation at low water by any but very light-draft boats. The original plan for improvement contemplated the removal of the obstructions and the improvement of the shoals, the latter by wing dams. A few sloughs were to be closed up so as to confine the water to the main channel. Up to June 30, 1888, $6,000 had been expended, which had opened up about 20 miles of river from Poplar Bluff towards the mouth. Up to June 30, 1890, $7,000 more had been expended in removing overhanging trees that had fallen across the channel, and dangerous snags for medium stage navigation from Poplar Bluff, Mo., to the Arkansas State line.

By act approved September 19, 1890, $7,000 was appropriated. During the fiscal year ending June 30, 1891, $3,914.21 was expended over the same reach, removing 406 dangerous snags, 23 piles of drift, and cutting 10,450 overhanging trees. High water prevented the expenditure of the balance, which will be duly applied to the carrying out of the project during the fiscal year. For further remarks, see report for "Improving Black River, Arkansas and Missouri."

Amount appropriated by act approved September 19, 1890	$7,000.00
June 30, 1891, amount expended during fiscal year	3,914.21
July 1, 1891, balance unexpended	3,085.79

(See Appendix W 9.)

10. *St. Francis River, Arkansas.*—Appropriations for this river have been made in connection with those for the White River. The first appropriation was made March 2, 1833, prior to which this river was choked with drift, logs, snags, and its waters spread out through a great variety of sloughs, while overhanging trees added to the difficulty of navigation. The originally adopted project was principally for snagging operations, and attempts have been made to close up some of the many sloughs.

On July 5, 1884, the first separate appropriation was made. From that time to June 30, 1890, $23,997.58 had been expended in carrying out the approved project. By act of September 19, 1890, $4,000 was appropriated. During the fiscal year ending June 30, 1891, $2,501.52 have been expended in continuance of the work and in the care of plant. The river has remained too high since the return of the boat from Little River, Missouri, for effective operations.

The balance will be expended early in the next fiscal year, between the mouth of the river and the town of Marked Tree, in snagging operations.

Twenty-eight thousand dollars can profitably be expended on this river during the fiscal year ending June 30, 1893.

July 1, 1890, balance unexpended	$2.42
Amount appropriated by act approved September 19, 1890	4,000.00
	4,002.42
June 30, 1891, amount expended during fiscal year	2,501.52
July 1, 1891, balance unexpended	1,500.90
July 1, 1891, outstanding liabilities	298.10
July 1, 1891, balance available	1,302.80
Amount (estimated) required for completion of existing project	28,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	28,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W 10.)

11. *St. Francis River, Missouri.*—The first appropriation made for this reach of river was that of act of August 11, 1888, in amount $5,000.

Prior to the work done with this sum, logs, snags, overhanging trees, and several shoals interfered with low-water navigation. The estimate, $7,300, proposed the removal of the shoals about 12 miles below Greenville and the removal of snags and other obstructions.

The amount appropriated by act of August 11, 1888, was inadequate. Up to June 30, 1890, $5,000 had been expended cutting a channel through the Big Drift and carrying out the other provisions of the original project.

By the act approved September 19, 1890, $10,500 was appropriated. The approved project for the expenditure of this sum differs from the original project only in the provision that a hand-propelled snag boat be built for use upon this reach and a short reach from St. Francis, Ark., to Kennett, Mo., which lies above the Sunk Lands.

During the fiscal year ending June 30, 1891, the snag boat was built and equipped. After it was completed, the water continued too high for effective operations until the close of the fiscal year. Early in the next fiscal year work will be continued.

Amount appropriated by act approved September 19, 1890	$10,500.00
June 30, 1891, amount expended during fiscal year	2,642.68
July 1, 1891, balance unexpended	7,857.32
July 1, 1891, outstanding liabilities	120.00
July 1, 1891, balance available	7,737.32

(See Appendix W 11.)

12. *Little River, Missouri and Arkansas.*—Before improvement this river was obstructed by snags, logs, masses of driftwood, and shoals, and was divided into two chutes. The project for improvement contemplates prolonging medium stage navigation by closing one of the chutes and removing the obstructions enumerated from the other.

As stated in my last report, damage to the hull of the snag boat and long-continued overflow prevented very much work until near the close of the fiscal year ending June 30, 1889, the first appropriation ever made for this river being that of the act of August 11, 1888, amounting to $5,000.

During the fiscal year ending June 30, 1891, operations were vigorously carried on until August 23, when work was suspended on account of low water. This carried the work to within 20 miles of the foot of the lake, and built a dam 300 feet long across the right chute.

By act approved September 19, 1890, $3,000 was appropriated.

It will be early in the next fiscal year before a boat will be available for this work or the stage of water suitable. The balance on hand will be expended in accordance with the original project, and will be sufficient for the present demands.

July 1, 1890, balance unexpended	$2,897.59
Amount appropriated by act approved September 19, 1890	3,000.00
	5,897.59
June 30, 1891, amount expended during fiscal year	2,865.69
July 1, 1891, balance unexpended	3,031.90

(See Appendix W 12.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Current River, from Van Buren, Missouri, to its mouth*, was made by the local engineer in charge, Captain Taber, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Taber, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The improvement proposed contemplates removing snags and contracting the channel over the shoals by a system of wing dams, at an estimated cost of $10,000. The report was transmitted to Congress and printed as House Ex. Doc. No. 157, Fifty-first Congress, second session. (See also Appendix W 13.)

The required preliminary examination at *Clarendon and the lower White River, Arkansas, to determine the effect of backwater from the Mississippi River and its cause and the means and cost of preventing injury therefrom*, was made by the local engineer in charge, Captain Taber, and report thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Taber, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Captain Taber was charged with its survey, the report on which will be submitted when received.

EXAMINATIONS OF MISSISSIPPI RIVER, AT MEMPHIS HARBOR, TENNESSEE; AND FROM LAKE COUNTY, TENNESSEE, TO FULTON COUNTY, KENTUCKY, NORTH AND WEST OF REELFOOT LAKE.

Officer in charge, Capt. S. W. Roessler, Corps of Engineers.

The preliminary examinations of the following localities, required by the river and harbor act approved September 19, 1890, were made by the local engineer in charge, and reports thereon submitted through Col. C. B. Comstock, Corps of Engineers, Division Engineer, Southwest Division. It is the opinion of Captain Roessler, based upon the facts and reasons given, that these localities are worthy of improvement; but Colonel Comstock, for reasons stated, does not consider them worthy of improvement. The views of Colonel Comstock being concurred in by me, no further surveys were ordered.

1. *Memphis Harbor, Tennessee, especially for the removal of the bar forming opposite the upper part of the city or the prevention of the river bank taking the form that the natural forces are now giving it.*—In transmitting to this office Captain Roessler's report of May 16, 1891, upon preliminary examination of this locality, Colonel Comstock states as follows:

> Captain Roessler has well described the present condition of the bar at the upper part of the Memphis front and the causes which led to its formation.
>
> The natural forces at work are now tending to give a new shore line, probably somewhere in the vicinity of the present low-water line. Those forces can be counteracted and their results be destroyed in two ways—either by extensive dredging annually repeated or by works on the Hopefield side, which will force the river back to its former position along the upper part of the Memphis front. Either of these methods will be very costly, especially the latter, and its success is not certain. The river is now so narrow that the bar apparently cannot advance much farther. These considerations have prevented the Mississippi River Commission from undertaking any new work at Memphis. Temporary relief up as far as the Anchor Line Elevator could be attained by a moderate amount of dredging.
>
> But, using the language of the act, "the removal of the bar forming opposite the upper part of the city or the prevention of the river bank taking the form that the natural forces are now giving it," is, in view of its great cost and uncertain results, in my judgment, not a work worthy of being done by the United States.

Captain Roessler's report is printed in Appendix D to the annual report of the Mississippi River Commission, herewith submitted.

2. *Mississippi River from high water mark Lake County, Tennessee, to high water mark Fulton County, Kentucky, north and west of Reef Foot [Reelfoot] Lake to ascertain if navigation of the river may not be improved by restraining the flow of water into said lake and adjoining low lands.*—(See Appendix X.)

REMOVING SNAGS AND WRECKS FROM MISSISSIPPI RIVER; IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN OHIO AND ILLINOIS RIVERS; OF HARBOR AT ST. LOUIS, AND OF OSAGE AND GASCONADE RIVERS, MISSOURI; AND OF KASKASKIA RIVER, ILLINOIS.

Officer in charge, Maj. A. M. Miller, Corps of Engineers; Division Engineer, Col. C. B. Comstock, Corps of Engineers.

1. *Removing snags and wrecks from Mississippi River.*—Before this work was inaugurated the navigation of the river was very much interfered with by numerous snags, logs, etc., which had lodged in the channel, and to which a new accession was brought down on each rise of the river, thus constantly adding new and unknown obstructions to those already there. A large number of wrecks also occupied the channel and were very dangerous to the safety of passing boats.

For the removal of these obstructions appropriations were made as early as 1824, and the project consisted in building boats suitable for removing the snags, etc., and operating them whenever the stage of water was favorable for the work and funds were available.

The total amount expended for this purpose can not be definitely given, as previous to the appropriation made by act of March 3, 1879, a general amount was appropriated to be applied to several streams as their needs required. From March 3, 1879, when the first specific appropriation was made, up to June 30, 1890, $718,289.80 was expended for this purpose. The navigation of the river has been very materially improved by this method and the danger to boats lessened.

During the fiscal year ending June 30, 1891, $92,470.97 was expended. Two snag boats were employed between the mouth of the Missouri River and Donaldsonville, La., removing obstructions. The boats worked for a

total of 16 months, removing 3,450 snags, cutting down 21,316 trees, removing 37 drift piles, and traveling a distance of 17,073 miles, thereby greatly benefiting navigation and commerce.

The boats were thoroughly overhauled and repaired and placed in good working order. An electric-light plant was also placed on the snag boat *Wright*. New boilers were ordered for the *Macomb*, but they had not been finished at the close of the fiscal year.

An annual appropriation having been made for carrying on this work, no further estimate is submitted.

Amount drawn under section 7, act of August 11, 1888	$92,500.00
June 30, 1891, amount expended during fiscal year	92,470.97
July 1, 1891, balance unexpended	29.03
July 1, 1891, amount available for fiscal year 1891–'92	100,000.00

(See Appendix Y 1.)

2. *Mississippi River between the Ohio and Illinois rivers.*—The original condition of the navigable channel of this portion of the Mississippi River, before the work of improvement was begun, was such that the natural depth at low water was in many places from 3½ to 4 feet, and the water was scattered by islands, which formed sloughs behind them, thus wasting the water available for low-water navigation.

The project adopted for improvement consists in closing these sloughs, and, by contraction works, the concentration of the water between banks 2,500 feet apart, the object being thereby to obtain a depth of 8 feet in the channel between St. Louis and Cairo, and 6 feet between Grafton and St. Louis at standard low water, or at a stage corresponding to a reading of 4 feet on the St. Louis gauge.

The amount expended up to the close of the fiscal year ending June 30, 1890, was $4,032,422.29. The condition of the improvement during the year past has been such that but little trouble was experienced between St. Louis and Lucas Crossing, a distance of 30 miles, as far as the work of improvement had been carried on June 30, 1891, and then only at extreme low water. For stages of water above 4 feet on the St. Louis gauge there has generally been a depth of at least 6 feet in the channel.

The amount expended during the fiscal year ending June 30, 1891, was $96,811.87, and was principally applied to the repair of plant. Owing to the late date at which the last river and harbor act was passed, it was impossible to get the plant in shape so as to do any work during the fall season and during the spring season, there being only one plant available, work was first done on the St. Louis Harbor, and after that was finished it was moved to St. Genevieve.

During the fiscal year work was carried on at the following localities:

Alton.—The work here consists of the extension of the present stone dike for a distance of 2,800 feet, the object being to prevent the formation of a bar in front of the landing at that place. The stage of water prevented any actual work being done, but a contract was entered into for the work, and it will be accomplished as soon as the stage of water will permit.

Rush Tower.—The project for work at this locality was adopted in 1890, and consisted in an extension of the general plan of improvement, so as to take in this locality. Work was not commenced until June 15, so that but little could be accomplished up to the close of the year. Two hurdles, Nos. 4 and 5 of this system, were located and partially built, and 600 feet of bank protection was placed in position. This bank protection was necessary, as the bank at one place had caved

so far as to be within 50 feet of the base of the levee, which protects the bottom lands from overflow. The amount expended at this locality was $3,926.06.

St. Genevieve.—The project for the improvement of this locality was adopted in 1890, and consisted in the construction of a series of hurdles on the Illinois side of the river, which were designed to prevent the channel leaving Little Rock, the landing for the town of St. Genevieve, and also to contract the river to a width of 2,500 feet. A system of four hurdles was contemplated, but owing to the fact that the bar at the foot of Turkey Island had moved so far downstream the upper hurdle was rendered unnecessary. Three hurdles, having a total length of 3,650 feet, were constructed and practically completed. The amount expended was $9,830.55.

Surveys.—A resurvey of the river between the foot of Horsetail Bar and Forest Home was made for the purpose of determining changes in the banks and channel of the river.

A reference to the plates accompanying the report of the officer in charge will give a graphic representation of the progress and effects of the works.

With the appropriation asked for fiscal year ending June 30, 1893, it is proposed to extend the general plan of improvement as far downstream as the funds available will permit.

The original estimated cost of this work, as revised in 1883, was $16,997,100, of which amount $4,529,600 has been appropriated.

July 1, 1890, balance unexpended		$97,177.71
Amount appropriated by act approved September 19, 1890		400,000.00
		497,177.71
June 30, 1891, amount expended during fiscal year		96,811.87
July 1, 1891, balance unexpended		400,365.84
July 1, 1891, outstanding liabilities	$20,720.86	
July 1, 1891, amount covered by uncompleted contracts	114,727.18	
		135,448.04
July 1, 1891, balance available		264,917.80
Amount (estimated) required for completion of existing project		12,467,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		1,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Y 2.)

3. *Harbor at St. Louis, Missouri.*—This work was originally part of the general improvement of the Mississippi River between the Illinois and Ohio rivers, and, as such, work was done at Sawyer Bend, Venice Dike, Arsenal Island, and Cahokia Chute Dam.

The river and harbor act of August 11, 1888, contained a provision for a special examination and survey of the harbor with a view to its improvement, and in a report made in December, 1888, it was stated that the St. Louis Harbor may be divided into two parts, the upper and the lower, the line of division being the Eads Bridge.

The lower portion, included between the river des Peres and the bridge, is 8 miles long, and the channel is good at all stages of water, the landings being easily accessible at all points.

The upper portion, included between the bridge and the northern limits of the city, is about 10 miles in length; of this portion the only part to be considered as at present included in the practical harbor is the reach between the bridge and the waterworks at Bissell Point, 3

miles in extent. This reach is obstructed by bars and shoals near the Illinois shore, which interfere with landings on that side and render navigation difficult.

As the result of this report an appropriation of $182,000 was incorporated in the river and harbor act of September 19, 1890, and the project adopted for the improvement of the harbor consisted in contracting the width of the river between the Merchants' and Eads bridges to an average width of about 2,000 feet by means of a system of hurdles to be built out from the Illinois shore.

The amount expended on this reach of the river prior to June 30, 1890, was for the extension and raising of dikes, previously built by the city of St. Louis, in Venice Bend, and was $36,341.85.

These dikes were only partially successful in improving the channel by deepening it at low water, the effect not being very marked.

During the fiscal year ending June 30, 1891, $109,303.77 was expended in building a system of hurdles between the Merchants' and Eads bridges and extending out from the Illinois shore. Eleven hurdles were built having an aggregate length of 12,400 feet.

It will take some time for the full effect of this work to be felt; a very appreciable fill has already taken place and it is confidently expected that in another low-water season the benefit of this work will be very apparent.

No appropriation is asked for fiscal year ending June 30, 1893, the amount appropriated in the last river and harbor act having been the full amount of the estimate.

With the balance remaining on hand it is proposed to construct one hurdle which was omitted for the present, and repair and strengthen the work whenever required.

Amount appropriated by act approved September 19, 1890		$182,000.00
June 30, 1891, amount expended during fiscal year		109,303.77
July 1, 1891, balance unexpended		72,696.23
July 1, 1891, outstanding liabilities	$41.06	
July 1, 1891, amount covered by uncompleted contracts	20,892.17	
		20,933.23
July 1, 1891, balance available		51,763.00

(See Appendix Y 3.)

4. *Gasconade River, Missouri.*—Before improvement this river was greatly obstructed by snags, logs, and leaning timber, which materially interfered with navigation. Work was commenced on this stream in 1880, and the project adopted for its improvement consisted in the removal of snags and logs, the cutting of leaning timber, and the construction of contraction works at shoal crossings.

The amount expended to June 30, 1890, was $42,072.35, and at that time the navigation was much improved by the work done. During the fiscal year ending June 30, 1891, $543.61 was expended in repairing plant and in quarrying stone to be used in raising the height of dam at Pryor Mill.

With the funds available it is proposed during the coming season to raise the crest of dam at Pryor Mill about 18 inches, also to remove such obstructions as may be found in the channel of the river. With the appropriation asked for fiscal year ending June 30, 1893, it is proposed to construct contraction works at other shoals and remove obstructions.

The original estimate for the improvement of this stream was $50,000. New obstructions are continually forming, and it will require appro-

priations from time to time to keep the channel open at low water after the principal work has been done.

July 1, 1890, balance unexpended	$427.65
Amount appropriated by act approved September 19, 1890	4,000.00
	4,427.65
June 30, 1891, amount expended during fiscal year	543.61
July 1, 1891, balance unexpended	3,884.04
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix Y 4.)

5. *Osage River, Missouri.*—Before any improvements were made, the navigation in this river was rendered difficult by reason of numerous snags and other obstructions, and at times suspended, owing to insufficient depth of water over shoal crossings.

The first improvement of this river was undertaken by the State of Missouri, about 30 to 35 years ago, and consisted in an attempt to concentrate the water in a narrow channel over the shoals by means of wing dams built out from one or both banks, and thus deepen it. This method was a failure, as at high water the increased velocity enabled the stream to move its gravelly bottom and fill up these passes.

The General Government assumed charge of the improvement in 1871, and the first efforts were expended in an attempt to deepen the water over the shoals by dredging, which resulted in failure, after this the method pursued consisting in building dams and training walls, so as to regulate the width of water way suitable to the low-water discharge of the river. This method is still pursued; snags and other obstructions found in the channel were also removed and leaning timber was cut from the banks.

The river and harbor act of September 19, 1890, contained provisions for the construction of a lock and dam near the mouth of the Osage, the details of which have not been entirely projected.

Estimates of the cost of obtaining habitual depths for navigation of 6 feet and 4 feet, respectively, by means of a series of locks and dams, are being prepared.

The amount expended to June 30, 1890, was $202,468.60, the result of which was that the navigation was materially improved, the channel having been cleared of the worst obstructions and the water deepened at several of the shoalest crossings.

During the fiscal year ending June 30, 1891, $3,460.87 was expended, principally in preparing plans, etc., for lock and dam, in gauging the river, and in repair of plant; efforts were also made to deepen the channel at Shipley Shoal, but sudden rises in the river prevented.

No complaints were received of snags, etc., interfering with navigation, and the lower 60 miles of the river was for the greater part of the year in good navigable condition.

New obstructions may be expected from time to time with each rise and fall in the river, and will require removal.

The estimated cost of a lock and dam, with a lift of 8 feet 6 inches, which will give a depth of 4 feet for navigation on the lower river, is $187,244; of the amount ($50,000) appropriated by the river and harbor act of September 19, 1890, it is proposed to expend what may be necessary in gauging the river and acquiring the requisite land for the lock and dam and keeper's dwelling, and retain the remainder until the amount appropriated will be sufficient to build the lock, or $140,000.

An appropriation of $110,000 is asked for fiscal year ending June 30, 1893, of which amount it is proposed to expend $100,000 in constructing lock, and $10,000 in removing obstructions, dredging, and building wing dams when found necessary.

July 1, 1890, balance unexpended	$2,531.40
Amount appropriated by act approved September 19, 1890	55,000.00
	57,531.40
June 30, 1891, amount expended during fiscal year	3,460.87
July 1, 1891, balance unexpended	54,070.53
July 1, 1891, outstanding liabilities	20.67
July 1, 1891, balance available	54,049.86
Amount (estimated) required for completion of lock and dam	137,244.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	110,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Y 5.)

6. *Kaskaskia River, Illinois.*—In 1886 Congress authorized an examination and survey of this stream with a view to its improvement. Formerly the mouth of the river was at Chester, Ill., but in 1881 a cut-off in the Mississippi occurred near the town of Kaskaskia, which moved the mouth of the river about 7 miles upstream. This benefited the navigation of the Kaskaskia, for the present mouth is at a point on the Mississippi River about 6 feet in elevation above its former mouth, and thus the backwater from the Mississippi gives this much more depth at the same stage, prolonging the season of low-water navigation.

At high water the river is navigable to New Athens; at low water it is obstructed by snags, shoals, and bars, and depends largely for its navigation upon the stage of the Mississippi. The least depth found at low water was about 9 inches, on what is called the "Nine-Mile Shoal," 6 miles above its mouth.

The project adopted for the improvement consists in deepening the water over the shoals by dredging and excavating, and in the removal of snags and other obstructions found in the channel.

Nothing has been expended on this improvement to June 30, 1890, nor was anything expended during the fiscal year ending June 30, 1891.

With the money now on hand and the amount asked for fiscal year ending June 30, 1893, it is proposed to deepen the channel over the shoals, and remove obstructions from the mouth to Baldwin Bridge and thus complete the improvement as contemplated.

Amount appropriated by act approved September 19, 1890	$6,000.00
July 1, 1891, balance unexpended	6,000.00
Amount (estimated) required for completion of existing project	4,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	4,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Y 6.)

IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN DES MOINES RAPIDS AND MOUTH OF ILLINOIS RIVER.

Officer in charge, Maj. E. H. Ruffner, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

The general project consists in contracting the low-water bed of the river to an average width of 1,800 feet. All island chutes are to be

closed by dams, and the river is to be contracted by wing dams where it is wider than the proposed low-water bed. The works are generally built of rock and brush, piling being seldom used. Caving banks and the heads of islands are protected. At times the low-water channel is deepened by dredging. Work was done last year at Cottonwood Island Reach, Sny Island Levee, near Scott Landing, foot of Hickory Chute, Buffalo Chute, and Clarksville Harbor, and in dredging in Quincy Bay.

July 1, 1890, balance unexpended		$25,142.00
Amount appropriated by act approved September 19, 1890		165,000.00
		190,142.00
June 30, 1891, amount expended during fiscal year		68,801.09
July 1, 1891, balance unexpended		121,340.91
July 1, 1891, outstanding liabilities	$6,694.77	
July 1, 1891, amount covered by uncompleted contracts	27,507.64	
		34,202.41
July 1, 1891, balance available		87,138.50
Amount that can be profitably expended in fiscal year ending June 30, 1893		300,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Z 1.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Mississippi River at Warsaw, Illinois, with a view of removing bar*, was made by the local engineer in charge, Major Ruffner, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Ruffner, and of the Division Engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 68, Fifty-first Congress, second session. (See also Appendix Z 2.)

IMPROVEMENT OF MISSISSIPPI RIVER BETWEEN MINNEAPOLIS AND DES MOINES RAPIDS, AND OF DES MOINES RAPIDS; OPERATING AND CARE OF DES MOINES RAPIDS CANAL AND DRY DOCK.

Officer in charge, Maj. A. Mackenzie, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Operating snag boats and dredge boats on Upper Mississippi River.*—At the beginning of the fiscal year there was available, under act of August 11, 1888, the sum of $25,000.

From July 16 to October 10, 1890, and from May 18 to June 30, 1891, the snag boat *General Barnard* was employed removing snags and other obstructions and assisting interests of navigation between Minneapolis and the mouth of the Missouri River.

The snag boat *J. G. Parke* was not put in commission in 1890; but, in 1891, after receiving thorough repairs, she was employed in connection with the dredging plant from May 10 to 29 and was then laid up at Nininger until the close of the fiscal year.

The dredge *Phœnix*, towed from point to point by the snag boat *General Barnard* and tended by the steam launch *Ada*, was employed from July to the beginning of October, 1890, in removing wrecks, cribs, etc., and in deepening the channel at various localities. In 1891, during June, she was engaged in deepening the permanent channel at Nininger.

The total amount expended for snag boat service on the Upper Mississippi River, between Minneapolis and the mouth of the Missouri River, to June 30, 1890, is $574,640.

There has been expended during fiscal year ending June 30, 1891, the sum of $25,000.

By the river and harbor act of August 11, 1888, provision was made for operating snag boats and dredge boats on the Upper Mississippi River under an indefinite appropriation, the sum so expended not to exceed the amount appropriated in said act for such purpose. The clause of the act regulating the annual expenditure for snag boats and dredge boats on the Upper Mississippi River is as follows: "For operating snag boats and dredge boats on Upper Mississippi River, twenty-five thousand dollars."

The total amount of freight transported on the Upper Mississippi River during the calendar year 1890 was approximately 4,400,000 tons.

June 30, 1891, amount drawn from Treasury under permanent appropriation	$25,000
June 30, 1891, amount expended during fiscal year	25,000
July 1, 1891, amount available under permanent appropriation of August 11, 1888, for fiscal year ending June 30, 1892	25,000

(See Appendix A A 1.)

2. *Mississippi River between Minneapolis and Des Moines Rapids.*—Prior to August 11, 1888, this work was carried on under appropriations for "improving Mississippi River from St. Paul to Des Moines Rapids." The act of August 11, 1888, extended the upper limits of the district from St. Paul to Washington Avenue Bridge, Minneapolis.

Under this appropriation is carried on the improvement of through navigation. Work has been in progress under approved projects since 1878, and very favorable results have been secured, showing that with a continuance of the work under liberal appropriations the low-water channel of the Mississippi River between St. Paul and the Des Moines Rapids can be made comparatively safe, convenient, and permanent. The interests for which the improvement is being made are very large and important. The amount of freight carried during 1890, including the logs and lumber floated in the river, aggregated, approximately, 4,400,000 tons.

The original condition of the channel between the Des Moines Rapids and St. Paul was such that in low stages the larger boats were unable to proceed farther up the river than La Crosse or Winona; and, in many seasons, at points much farther down their progress was checked or seriously interfered with. In all such cases through freight was reshipped on small and light-draft boats or barges. The originally adopted project for the improvement, which has not been materially changed, proposed the contraction of the channel or water way by means of wing and closing dams, to such an extent as, by means of the scour thereby caused, to afford a channel of sufficient width and of a depth of 4.5 feet at low water, to be eventually increased to 6 feet. There was expended on the permanent improvement of through navigation to June 30, 1890, the sum of $2,097,441.64, or $4,010 per mile. At that date and for several years previous, the condition of the channel was such as to permit the passage of the largest boats at the lowest stages through to St. Paul.

During the past year work has been carried on by days' labor and use of Government plant between Minneapolis and St. Paul, between St. Paul and Prescott, in vicinity of Fountain City, Winona, Clinton, and Minneiska, at Rock Island Rapids and Montrose Harbor, and between Keithsburg and Des Moines Rapids; by contract, between

Read Landing and Minneiska, and in vicinity of Prairie du Chien; and, by informal agreement, at Read Landing, Burlington, and Port Byron. Temporary work in deepening channels by dredging was performed at several points. The work of the year has resulted in increased width and depth of channel at all the points mentioned above.

It is estimated that there can be expended to advantage during the fiscal year ending June 30, 1893, for the continuation of the improvement of the low-water channel of the Mississippi River from Minneapolis to Des Moines Rapids, the sum of $1,500,000.

July 1, 1890, balance unexpended		$64,196.24
Received by transfer settlement with Quartermaster's Department, account of sale of fuel to officers		156.29
Amount appropriated by act approved September 19, 1890		500,000.00
		564,352.53
June 30, 1891, amount expended during fiscal year		152,961.67
July 1, 1891, balance unexpended		411,390.86
July 1, 1891, outstanding liabilities	$2,277.94	
July 1, 1891, amount covered by uncompleted contracts	50,834.11	
		53,112.05
July 1, 1891, balance available		358,278.81
Amount that can be profitably expended in fiscal year ending June 30, 1893		1,500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix A A 2.)

3. *Des Moines Rapids, Mississippi River.*—This work was commenced in 1866. The adopted plan provided for the building of a closed canal 8 miles long and for cutting an open channel in the rock bed of the river over the remaining 4 miles of rapids. The canal was opened in August, 1877, though not fully completed, and has been in operation since that time.

During the past year the work of protecting the outside slope of the canal embankment was nearly finished, as well as the raising of the middle lock walls. The work remaining to be done under approved project is the removal of a small amount of rock above grade, the completion of sluice at Price Creek, and the completion of the lock grounds, and of the protection of canal embankment.

There has been appropriated and allotted for this work the sum of $4,574,950. The net cost to the United States has been, to June 30, 1890, $4,538,013.68.

July 1, 1890, balance unexpended	$348.14
Amount appropriated by act approved September 19, 1890	22,000.00
	22,348.14
June 30, 1891, amount expended during fiscal year	12,117.15
July 1, 1891, balance unexpended	10,230.99

(See Appendix A A 3.)

4. *Operating and care of Des Moines Rapids Canal and Dry Dock.*—During the past year the Des Moines Rapids Canal was open for navigation 234 days, during which time there passed through it 878 steamboats and 357 barges, carrying 15,801 passengers, 45,217 tons of merchandise, and 364,878 bushels of grain. There also passed through 193,358,089 feet B. M. of lumber, 37,176,150 feet of logs, 87,259,690 shingles, and 59,350,595 laths. The expenses of the year have been $44,998.20 and the estimates for the coming year amount to $70,000.

The cost of operating and care of the canal is provided for by an indefinite appropriation made by act of March 3, 1881.

July 1, 1890, balance on hand	$1,004.20
June 30, 1891, amount drawn from Treasury under indefinite appropriation	43,995.80
	45,000.00
June 30, 1891, amount expended during fiscal year	44,998.20
June 30, 1891, balance on hand	1.80

(See Appendix A A 4.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *slough at Hamilton, Illinois, with a view to dredging out the same*, was made by the local engineer in charge, Major Mackenzie, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Mackenzie, and of the Division Engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 72, Fifty-first Congress, second session. (See also Appendix A A 5.)

The required preliminary examination of *Mississippi River at and above Clinton, Iowa, with view of removing bars north of Little Rock Island*, was made by the local engineer in charge, Major Mackenzie, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Mackenzie, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Major Mackenzie was charged with and has completed its survey and submitted report thereon. The only work which appears advisable or necessary at the present time in connection with the removal of bars above the island is a closing dam between Little Rock Island and the tow-head to its left, the cost of which is estimated to be $5,000. This locality is a part of the Upper Mississippi River, for the improvement of which an appropriation is provided; and while the locality is certainly worthy of improvement at the proper time, there are no conditions which necessitate a special appropriation for the work. All necessary work in this locality can be carried out, whenever found necessary, under allotments from the general appropriation for improving the Mississippi River from Minneapolis to the Des Moines Rapids. The reports were transmitted to Congress and printed as House Ex. Doc. No. 135, Fifty-first Congress, second session. (See also Appendix A A 6.)

IMPROVEMENT OF MISSISSIPPI RIVER ABOVE FALLS OF ST. ANTHONY, MINNESOTA, OF CHIPPEWA RIVER, WISCONSIN, OF ST. CROIX RIVER, WISCONSIN AND MINNESOTA, OF MINNESOTA RIVER, MINNESOTA, AND OF RED RIVER OF THE NORTH, MINNESOTA AND NORTH DAKOTA; GAUGING MISSISSIPPI RIVER AT OR NEAR ST. PAUL, MINNESOTA.

Officer in charge, Maj. W. A. Jones, Corps of Engineers, having under his immediate orders Lieut. William E. Craighill, Corps of Engineers, to May 31, 1891, and Lieut. Hiram M. Chittenden, Corps of Engi-

neers, since June 5, 1891; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Mississippi River above Falls of St. Anthony, Minnesota.*—The present project, adopted in 1880, consists in improvement of the river between Aitkin and Grand Rapids, a distance of 130⅛ miles, by removal of snags, bowlders, bars, and leaning trees from the channels, and construction of wing dams, where necessary, to afford 3 feet depth during low-water stage, the cost being estimated at $54,127. In 1889 the estimate was increased to $63,000. Under the appropriations of 1880, 1881, and 1882 the river between the points named was well cleared of large numbers of obstructions. But between 1884 and 1888, and during the flood of the latter year, large numbers of snags and overhanging trees were formed. The appropriation, $10,000, by the act of August 11, 1888, was applied to removal of obstructions between Grand Rapids and a point about half way to Aitkin, and in addition a number of bowlders were removed to within 20 miles of the latter point.

Before improvement commenced in 1880 the stream between Aitkin and Grand Rapids was so obstructed that navigation was difficult and at times almost impossible for steamers of lightest draft.

Total expended to June 30, 1890, including outstanding liabilities, $44,960.13.

There was then a general depth in the improved channels, except on the rapids, of 3 feet at low water. On the rapids the channel depths were but 2 feet; a few snags and leaning trees offered some obstruction, but did not seriously interfere with navigation.

During the past winter work was carried on in improving all the rapids between Brainerd and Aitkin by removing bowlders, excavating sand and gravel, and constructing wing dams where necessary. The result of the season's work was an increased depth of 1 foot over the shoal places, making a continuous channel between the points named with a least depth of 3 feet at low water.

Amount expended during the fiscal year ending June 30, 1891, including outstanding liabilities, $10,479.22.

For a number of years previous to the present season several steamers have navigated this portion of the Mississippi, carrying passengers and freight to the settlements and supplies for lumber camps.

The opening, winter before last, of the Duluth and Winnipeg Railroad, from Duluth to the Mississippi River, resulted in one steamboat being withdrawn from the freight and passenger business, though at the beginning of the season of 1891 she was again put into commission.

July 1, 1890 balance unexpended	$43.54
Amount appropriated by act approved September 19, 1890	18,000.00
	18,043.54
June 30, 1891, amount expended during fiscal year	10,451.27
July 1, 1891, balance unexpended	7,592.27
July 1, 1891, outstanding liabilities	31.62
July 1, 1891, balance available	7,560.65

(See Appendix B B 1.)

2. *Reservoirs at headwaters of Mississippi River.*—The object of the reservoirs is to collect surplus water, principally from the precipitation of winter, spring, and early summer, to be systematically released so as to benefit navigation upon the Mississippi River below the dams. The reservoir project is the outcome of surveys and examinations made in 1869, 1874, 1878, and 1879. From the results of these examinations and

further examinations made in 1880, the first cost of constructing reservoir dams in Minnesota and Wisconsin was placed at $1,809,083. The cost of land and other damages to result from construction and operation of the proposed dams was not included in that estimate, as they could not be predicted with any approach to accuracy.

The present project consists in constructing reservoir dams at the headwaters of the Mississippi River in Minnesota, that locality having been selected for commencing the work, in consequence of an appropriation made by the river and harbor act approved June 14, 1880, for construction of a reservoir dam at Lake Winnibigoshish, Minnesota, and for other reasons, given in Appendix Y to the Annual Report for 1886. By 1886 four of the reservoirs had been created.

Total expended on this work to the close of the fiscal year ending June 30, 1890, including examinations at proposed dam sites, land damages, amounts set aside as awards to Indians, and care and maintenance of the works, $623,986.63.

During the past year, the operations have been in the main confined to operating the reservoirs.

Condemnation proceedings to acquire title to lands between Pokegama Falls and Blackberry Brook that are liable to be overflowed by the operation of the reservoirs were commenced, but afterwards discontinued as it was deemed more economical to obtain title, or the right to overflow, through private purchase.

Plans for the Sandy Lake Dam have been prepared and preparations for its construction are being made.

Expended during the fiscal year ending June 30, 1891, including outstanding liabilities, $11,526.74.

The reservoirs were operated, 1885–'90, during the seasons of low water, to the benefit of navigation on more than 165 miles of the Mississippi River, viz: Between Grand Rapids and Aitkin, 130⅛ miles, and from St. Paul to some distance below the confluence of the Mississippi and St. Croix rivers.

The officer in charge recommends appropriations for constructing a navigable pass in the Sandy Lake Dam, now in course of construction; for excavations at Leech Lake and Lake Winnibigoshish, in order to increase the facility for releasing water from the reservoirs at those places, and in hydrological and meteorological observations, to determine the effect of the reservoir water. The latter purpose is specially worthy of consideration, for the result of the observations extending over a period of several years would determine the true effectiveness of the reservoirs.

The amounts asked for are—

Navigable pass in Sandy Lake Dam	$30,000.00
Maintenance and ordinary repairs	19,000.00
Excavations at the two upper dams	11,000.00
Hydrological and meteorological investigations	15,000.00
Total	75,000.00
July 1, 1890, balance unexpended	11,799.34
Amount appropriated by act approved September 19, 1890	80,000.00
	91,799.34
June 30, 1891, amount expended during fiscal year	11,772.23
July 1, 1891, balance unexpended	80,027.11
July 1, 1891, outstanding liabilities	1,040.48
July 1, 1891, balance available	78,986.63

Amount (estimated) required for completion of existing project	$1,094,583.50
Amount that can be profitably expended in fiscal year ending June 30, 1893	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 2.)

3. *Chippewa River, including Yellow Banks, Wisconsin.*—The plan for improvement of the Chippewa River consists in revetment of caving bends and construction of dams and jetties from Eau Claire to the confluence of the Chippewa and Mississippi, a distance of 57 miles, to confine the low-water volume to a channel of nearly uniform width and depth. The general plan was adopted in 1877, and the work has been carried on in accordance with it, varying, however, more or less, as to location and extent of dams, jetties, etc. The protection of the Yellow Banks consists in a revetment of piling and fascines, the latter to be crowned with rock. The object of the Yellow Banks protection is to prevent their erosion, and thus to relieve the channels of the Chippewa River and of the Mississippi below the junction of the two streams from the masses of sand contributed by those banks. The plan for protecting the banks was adopted in 1883. The improvement of the river and the protection of the Yellow Banks were regarded as separate and distinct works until the act of August 11, 1888. Estimated cost of the consolidated improvement, including all expenses from the commencement, $272,487.72.

Before the improvement commenced the depth on the bars at low water seldom exceeded 18 inches, and the crossing at the mouth of river was extremely difficult at that stage, owing to the volume of the river joining the Mississippi through a number of channels of insufficient depth. These latter-named channels were contracted into one of good depth by means of long parallel jetties. Generally, wherever works for improvement were constructed by the Government, the low-water depths were increased from 18 inches to 3 to 4 feet, and the general improvement not only greatly facilitated the passage of steamers and rafts, but also greatly reduced the expense of rafting manufactured lumber.

Localities remaining to be improved have a least depth in the channel of about 2 feet.

Total expended from commencement of operations in 1877 to June 30, 1890, including outstanding liabilities, $156,048.25.

Owing to the lateness of the season when the current appropriation became available, no work other than care of plant has been done during the past fiscal year. Work will be resumed in July or August.

Expended during the fiscal year ending June 30, 1891, including outstanding liabilities, $1,359.41.

July 1, 1890, balance unexpended		$904.35
Amount appropriated by act approved September 19, 1890		10,000.00
		10,904.35
June 30, 1891, amount expended during fiscal year		1,468.48
July 1, 1891, balance unexpended		9,435.87
July 1, 1891, outstanding liabilities		93.53
July 1, 1891, balance available		9,342.34

Amount (estimated) required for completion of existing project	105,737.72
Amount that can be profitably expended in fiscal year ending June 30, 1893	60,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 3.)

4. *St. Croix Rixer, Wisconsin and Minnesota.*—The original project for improvement, adopted in 1878, was based upon a survey made in 1874 when the river was at a high stage of water and but comparatively few obstructions to be seen. It contemplated removal of snags, bowlders, sand bars, etc., and contraction of the low-water channels from Taylor Falls to the confluence of the river with the Mississippi into one of nearly uniform width. Estimated cost, $21,758. At low water, however, the channel had in many places but 2 feet of depth, and steamers and barges made their way as best they could amongst the obstructions; at times it was impossible for them to get over the shoal places. The present project, adopted in 1880, and modified as to cost in 1882 and again in 1889, is based upon a low-water survey made in 1879, and differs from that originally adopted only in amount of work to be done. Estimated cost, $108,700.

Expended under present project to June 30, 1890, including outstanding liabilities, $74,455.94.

Total expended under original and present projects to June 30, 1890, including outstanding liabilities, $92,455.94.

The effect of the work of improvement has been to secure a least depth of 3 feet on the improved bars above Stillwater, and 4 to 5 feet on the bars below that place. Generally, it may be said of this improvement that at many points navigation has been rendered permanent where formerly it was uncertain, and that in other places it has been made practicable where before improvement it was impossible.

In the improved parts of the river above Stillwater there is a low-water depth in the channel of 2 feet; below Stillwater there is a good channel with a least depth of 4 feet.

The work of improvement during the past year has consisted in dredging a channel through a bar at the lower end of the St. Croix boom (above Stillwater) and in widening the channel at upper and lower end of the Hudson bar (below Stillwater). The first improvement opened up a channel where boats engaged in the freight and passenger business had experienced considerable trouble. The work at Hudson enabled the raft boats with their large tows to more easily make the run over the bar.

Expended during the fiscal year ending June 30, 1891, including outstanding liabilities, $6,262.

July 1, 1890, balance unexpended	$65.69
Amount appropriated by act approved September 19, 1890	8,000.00
	8,065.69
June 30, 1891, amount expended during fiscal year	3,268.70
July 1, 1891, balance unexpended	4,796.99
July 1, 1891, outstanding liabilities	3,014.93
July 1, 1891, balance available	1,782.06
Amount (estimated) required for completion of existing project	26,200.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	26,200.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 4.)

5. *Minnesota River, Minnesota.*—From 1867 to 1873, Congress appropriated $77,500 for improving the Minnesota River. The appropriations were applied to removing snags and bowlders, so as to afford a least depth at low-water stage of 2 to 3 feet. In 1874 a survey was made from the mouth of the river to South Bend, a distance of about

116 miles, to determine the practicability of improving the navigation by means of canals, locks, and dams. Based upon this survey, estimates were made for 5 locks and dams and removal of snags, etc., at a cost of $733,868.63, the cost of removing snags, etc., being therein placed at $34,585.10, including contingencies. Following this report Congress made three appropriations of $10,000 each by acts approved March 3, 1875, August 14, 1876, and June 18, 1878, which sums were applied to clearing the river of obstructions below South Bend.

Expended to June 30, 1879, $117,457.

Since 1879 no work for improvement of the river has been undertaken. Under the appropriations above named the removal of obstructions cleared the way over long stretches of the river between Minnesota Falls and a point about 30 miles below Henderson (16.7 miles above Shakopee). Little or no use was made of the cleared channels, as there was not sufficient depth of water in the channel to permit navigation during the low-water periods. The rapidly caving banks on the upper section of this stream cause snags and leaning trees to form, so that channels which were cleared of them 12 years ago are more or less incumbered with them to-day.

No expenditures have been made for the improvement of the lower part of the river, which offers much better facilities for river traffic than the upper part. From Shakopee to the Mississippi the river is deep, except on two bars. There are few snags on this reach.

The river and harbor act of August 11, 1888, appropriated $10,000 for improving the Minnesota River, including protection of the banks opposite the borough of Belle Plaine. It appearing from an examination made in September, 1888, that the sum was inadequate for the purposes named, its expenditure for work for improvement was deferred until the further wishes of Congress in the matter might be known.

Total expended on the improvement of the whole river to the close of the fiscal year ending June 30, 1890, $117,532.

Expended during the year ending June 30, 1891, $0.79.

July 1, 1890, balance unexpended	$9,967.00
July 1, 1891, balance unexpended	9,967.00
July 1, 1891, outstanding liabilities	9.79
July 1, 1891, balance available	9,957.21
Amount (estimated) required for completion of existing project	693,868.63
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix B B 5.)

6. *Red River of the North, Minnesota and North Dakota.*—The project for the improvement of this river from Breckenridge to the northern boundary line, adopted in 1877, and amended as to cost in 1883, consists in the removal of snags, leaning trees, and bowlders, and in dredging channels through the bars, at an estimated cost of $179,310. A revised estimate made in 1887 placed the cost of completing the improvement at $79,598.37.

Before improvement the ruling depth upon bars between Moorhead and Goose Rapids at ordinary low water was but 1½ feet, and below Grand Forks 2 feet, while between Moorhead and Abercrombie the navigation was at all times difficult.

The work to June 30, 1890, has resulted in opening a channel 3 feet deep at ordinary low water and 60 feet wide from Moorhead to a point

80 miles north, and a channel 4 feet deep at ordinary low water and about 70 feet wide from Grand Forks to a point 62 miles north by river; also in the removal of snags and trees between Moorhead and Abercrombie so as to afford safe passage for steamers between those points during high and medium stages of water.

Total amount expended, including outstanding liabilities, to June 30, 1890, $187,042.79.

Continued low water throughout 1890 confined operations to repairing the fleets until the spring of 1891. Active dredging work was resumed early in May by placing both dredges in commission. Dredge No. 1 is operating at Pelican bars, 92 miles north of Grand Forks; Dredge No. 2 commenced 13 miles north of Grand Forks and is rapidly working over a river passed over in previous years toward Dredge No. 1.

The excavated channels are 4 feet in depth and aggregate 8,310 feet in length; 44,535 cubic yards material was removed.

Amount expended during the fiscal year ending June 30, 1891, including outstanding liabilities, $11,889.79.

July 1, 1890, balance unexpended	$4,770.48
Amount appropriated by act approved September 19, 1890	25,000.00
	29,770.48
June 30, 1891, amount expended during fiscal year	10,611.65
July 1, 1891, balance unexpended	19,158.83
July 1, 1891, outstanding liabilities	3,143.76
July 1, 1891, balance available	16,015.07
Amount (estimated) required for completion of existing project	34,598.37
Amount that can be profitably expended in fiscal year ending June 30, 1893	34,598.37

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix B B 6.)

7. *Gauging Mississippi River at or near St. Paul, Minnesota.*—The Board of Engineers, to whom was referred the project for the application of $37,500 appropriated by the river and harbor act of August 5, 1886, for reservoirs at the head waters of the Mississippi River, recommended in their report dated May 24, 1887, "that such gaugings be made at or near St. Paul during the annual operation of the reservoirs as shall determine accurately the discharge at that point at critical periods." (Page 1692, Annual Report Chief of Engineers, 1887.)

The river and harbor act of August 11, 1888, authorized the gaugings and provided for them as follows:

> And the Secretary of War shall cause such gaugings to be made at or near Saint Paul during the annual operation of said reservoirs as shall determine accurately the discharge at that point, the cost of the same to be paid out of the annual appropriation for gauging the waters of the Mississippi River and its tributaries.
>
> * * * * * * *
>
> SEC. 6. That for the purpose of securing the uninterrupted gauging of the waters of the Lower Mississippi River and its tributaries, as provided for in joint resolution of the twenty-first of February, eighteen hundred and seventy-one, upon the application of the Chief of Engineers, the Secretary of War is hereby authorized to draw his warrant or requisition from time to time upon the Secretary of the Treasury for such sums as may be necessary to do such work, not to exceed in the aggregate for each year the amount appropriated in this act for such purpose: *Provided, however,* That an itemized statement of said expenses shall accompany the Annual Report of of the Chief of Engineers.

Gaugings were not made until the fall of 1889, although an allotment of $900 for the fiscal year ending June 30, 1889, had been made. On

account of the lateness in the season and the condition of the river, it was not deemed advisable to expend any of the money that year.

The allotment of $600 made August 23, 1889, for the fiscal year ending June 30, 1890, was applied to gauging the Mississippi River at St. Paul, and when necessary the Minnesota River at its mouth. There were in all 45 gaugings made during the months of September and October, 1889, and February and March, 1890.

With the allotment of $900 for the fiscal year ending June 30, 1891, 62 gaugings were made.

Amount allotted for fiscal year ending June 30, 1891	$900.00
Amount allotted for fiscal year ending June 30, 1292	900.00
	1,800.00
June 30, 1891, amount expended during fiscal year	620.93
July 1, 1891, balance unexpended	1,179.07
July 1, 1891, outstanding liabilities	279.07
July 1, 1891, balance available	900.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	4,600.00

(See Appendix B B 8.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Jones, and reports thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Jones, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the fifty-first Congress, second session.

1. *Harbor at Hudson, Wisconsin, with a view to prevent the city being cut off from the navigable channel of the Saint Croix Lake, as a result of the Government dike now constructed at that point, and with a view to the feasibility of conducting the waters of Willow River past the city of Hudson into the navigable channel of the lake.*—Printed as House Ex. Doc. No. 268. (See also Appendix B B 9.)

2. *Red River of the North, North Dakota and Minnesota, with a view of improving the navigation of the same by the construction of a lock and dam at Goose Rapids in said river.*—Printed as House Ex. Doc. No. 292. (See also Appendix B B 10.)

3. *Creel's Bay, Totten Bay, and Minnewauken Shoals, in Devil's Lake, North Dakota, with an estimate of the cost of improving the same by dredging or otherwise, so as to re-establish the navigation of said lake.*—Printed as House Ex. Doc. No. 293. (See also Appendix B B 11.)

The required preliminary examination of *Red River and tributaries above Fergus Falls and Crookston, and of Big Stone Lake, Minnesota, with a view to improving navigation thereon by the erection of suitable dams, or by such other means as may be deemed best*, was made by the local engineer in charge, Major Jones, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest

Division. It is the opinion of Major Jones, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Major Jones was charged with its survey, the report on which will be submitted when received.

EXAMINATION OF MISSOURI RIVER, FROM THE OLD MOUTH OF THE PLATTE RIVER, LITTLE POINT, TO A POINT OPPOSITE THE CITY OF LEAVENWORTH; ALSO OF THE RIVER AT THE CITY OF WESTON, MISSOURI, WITH A VIEW OF RETURNING SAID RIVER TO ITS ANCIENT CHANNEL, AND THE BEST PLAN OF ACCOMPLISHING THE SAME.

Officer in charge, Lieut. Col. Charles R. Suter, Corps of Engineers.

The preliminary examination of Missouri River at these localities, required by the river and harbor act approved September 19, 1890, was made by the local engineer in charge, and report thereon submitted. It is the opinion of Lieutenant-Colonel Suter, based upon the facts and reasons given, that these localities are not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. (See Appendix C C.)

IMPROVEMENT OF MISSOURI RIVER ABOVE SIOUX CITY, IOWA, AND OF YELLOWSTONE RIVER, MONTANA AND NORTH DAKOTA.

Officer in charge, Capt. Chas. F. Powell, Corps of Engineers, since November, 1890; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Missouri River between the Great Falls, Montana, and Sioux City, Iowa.*—This work had been under the control of the Missouri River Commission. The river and harbor act of September 19, 1890, having made a separate appropriation for the river above Sioux City, to be expended in the discretion of the Secretary of War, the work was, November 30, 1890, placed in charge of Capt. Charles F. Powell, Corps of Engineers, under the supervision of the Chief of Engineers.

The river above Fort Benton, the head of navigation, to the foot of the falls is seriously obstructed by numerous rapids and rocks. This part of the river is the tailing out of the Great Falls. No work has been done upon it and none is proposed.

From Fort Benton to Carroll, Mont., called the rocky river, 168 miles long, the channel was originally obstructed by bowlders, short turns, and sharp slopes and insufficient low-water depth on bars for 30-inch-draft boats. The original project was to remove obstructive bowlders. To this was added the building of cut-off and wing dams for causing scour of the bottom, or lengthening of the slopes by raising the water at their lower ends, or for both these objects; dredging was also added to the project.

To June 30, 1890, $306,028.45 has been expended on this project. To that date the most obstructive bowlders had been removed and the bad rapids otherwise ameliorated, giving a 3-foot or deeper channel at the improved places, except at extreme low water.

Previous to the adoption of the project named, work had been done on the rocky river and on the river above Great Falls under appropriations of $160,000 for improving the Missouri River above the mouth of the Yellowstone; the part done on the rocky river consisted of rock removal and the building of dams to raise the water on the bars.

During the year ending June 30, 1891, the vessels and plant, belonging on the rocky river, and which had been laid up a long time, were repaired and otherwise made more efficient, and the dams at the three rapids next below Fort Benton repaired and extended, and at two of the places ballasted with rock.

On the sandy river, viz, below Carroll, the river becomes more and more unstable going down-stream, and carries more and more sediment, until at Sioux City it is called the "big muddy," the banks in the bottoms cave, numerous shoals exist, and floods and ice gorges occasionally cause cut offs or radical shiftings of the channel. The project was introduced during the last year to remove snags, wrecks, and other obstructions on this part of the river and to temporarily improve the worst crossings. A snag-boat and a snagging scow were built and will be ready for service as soon as the June high water subsides. The engineer in charge recommends, in order that the operation of the snag-boats may be uninterrupted, that the appropriation for this service be separate and be made continuous, the same as provided for the Upper and Lower Mississippi and Ohio rivers in the river and harbor acts of 1888 and 1890. Fifty thousand dollars annually is estimated for this service.

Examinations have been made for the selection of sites for the two ice-harbors contemplated by the act of September 19, 1890.

Up to June 30, 1890, there had been expended $67,000.64 on a systematic and detailed river survey; the field work of the triangulation between river bluffs was then completed; the primary levels run from Fort Benton to Trover and other field work done from Fort Benton to Coal Banks and Trover Point, Mont., 41 and 232 miles.

During the year ending June 30, 1891, the expenditure for the river survey was $14,533.95 and has resulted in the extension of the topography and hydrography to Wolf Point, and of the primary levels to Poplar, Mont., 382 and 415 miles from Benton, with a duplication of the levels from Trover to Wolf Point; the office work of the triangulation was completed, other field work reduced, and two series of maps projected and partly drawn.

The appropriation asked for is to complete the river survey, for limited work on the rocky river, for removal of snags, wrecks, etc., on the sandy river, and for reclaiming the steamboat landings at Pierre and Yankton, S. Dak.

Amount appropriated by act approved September 19, 1890		$300,000.00
June 30, 1891, amount expended during fiscal year *		32,103.89
July 1, 1891, balance unexpended		267,896.11
July 1, 1891, outstanding liabilities	$12,459.77	
July 1, 1891, amount covered by uncompleted contracts	53,057.25	
		65,517.02
July 1, 1891, balance available		202,379.09
Amount (estimated) required for completion of existing project		300,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix D D 1.)

2. *Yellowstone River, Montana and North Dakota.*—In charge of Maj. W. A. Jones, Corps of Engineers, to November 19, 1890. The project consists in rock removal and building closing-dams and wing-dams for

*Exclusive of expenditures from balances in hands of Missouri River Commission.

confining the water to one channel, from Glendive, Mont., to the mouth of the river. The amount expended thereon to June 30, 1890, is $106,823.55.

The channel was originally obstructed by rocks, and also, and now in part, by swift rapids, sharp turns, and insufficient depths at bars.

For reasons given in Appendix X 2 of the Report for 1887, the project is suspended in order that the whole might be reported to Congress.

There was formerly a brisk river traffic, but now there are no boats on the river.

July 1, 1890, balance unexpended	$11,926.45
June 30, 1891, amount expended during fiscal year	160.25
July 1, 1891, balance unexpended	11,766.20
July 1, 1891, outstanding liabilities	.71
July 1, 1891, balance available	11,765.49
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	106,000.00

(See Appendix D D 2.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Tongue River, Montana, with a view of determining the practicability and approximate cost of straightening the channel of said river, immediately west of Miles City and north of the Northern Pacific Railroad track*, was made by the local engineer in charge, Captain Powell, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Captain Powell, and of the Division Engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 118, Fifty-first Congress, second session. (See also Appendix D D 3.)

The required preliminary examination of *Yellowstone River, Montana, from its mouth to the mouth of Tongue River*, was made by the local engineer in charge, Captain Powell, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Captain Powell, based upon the facts and reasons given, that Yellowstone River is worthy of improvement below, but not above, Glendive; but Colonel Poe considers that the present and prospective commerce is insufficient to justify the improvement of any portion of Yellowstone River by the general Government. The views of Colonel Poe being concurred in by me, no further survey was ordered. (See Appendix D D 4.)

The required preliminary examination of *Missouri River between Sioux City and Fort Benton*, was made by the local engineer in charge, Captain Powell, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. This report includes also the required report on *Missouri River, Nebraska and South Dakota, from the mouth of the Big Sioux River to the north line of the State of South Dakota*. It is the opinion of Captain Powell, and of the Division

Engineer, based upon the facts and reasons given, that Missouri River between Sioux City and Fort Benton is worthy of improvement. This opinion being concurred in by me, Captain Powell was charged with the survey of these sections of the river and has submitted reports thereon. The following plan and estimate for improvement between Sioux City and Fort Benton are submitted:

Completion of necessary work on rocky river below Judith, Mont	$50,000
Rectification of the river at and near Pierre and Yankton, S. Dak	150,000
Completion of river survey and publication of maps	74,497
	274,497

If bank protection at Pierre is undertaken, $25,000 additional will be required.

Annual appropriations of $55,000 will be required, as follows:

Operation of snag-boats and temporary improvement at the worst bars on the sandy and muddy river	$50,000
Maintenance of ice-harbor at Rock Haven	5,000
	55,000

(See Appendix D D 5.)

The required preliminary examination of *Missouri River, Montana, between Great Falls and canyon next below Stubbs Ferry*, was made by the local engineer in charge, Captain Powell, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Captain Powell, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement, and this opinion was concurred in by me. No new survey of this reach of Missouri River is necessary at this time; but in order to obtain use of the results of surveys heretofore made, an allotment was made for preparation of maps, and Captain Powell was directed to submit a final report with plan and estimate for improvement. The report will be submitted when received.

IMPROVEMENT OF TENNESSEE RIVER ABOVE CHATTANOOGA, TENNESSEE, AND BELOW BEE TREE SHOALS, ALABAMA, OF CUMBERLAND RIVER, TENNESSEE AND KENTUCKY, AND OF THEIR TRIBUTARIES IN EASTERN TENNESSEE AND KENTUCKY.

Officer in charge, Lieut. Col. J. W. Barlow, Corps of Engineers, having under his immediate orders Lieut. George W. Goethals, Corps of Engineers, to March 18, 1891, and Lieut. John Biddle, Corps of Engineers, since April 11, 1891.

1. *Tennessee River.*—(*a*) *Above Chattanooga, Tennessee* (194 *miles*).—Examinations of this section of the river were made in 1830 and 1871, and the principal obstructions were found to be rock-reefs, gravel-bars, and shoals having about 15 inches of water over them at low stages, also snags, etc., brought down by the annual floods.

The original project was to blast a channel through the reefs, reduce the gravel and sand bars, and to deepen the water on the bars by the construction of wing-dams, thus contracting the waterway so as to secure a safe, navigable channel, 3 feet in depth at average low water.

The amount expended to June 30, 1890, including outstanding indebtedness, was $237,252.80, which expenditure has resulted in a lengthened season of navigation for steamboats and a safer channel for the passage of flatboats and rafts.

Of the forty-three obstructions enumerated, channel work has been

carried on to the extent of improving at least twenty-nine of them. Owing to the character of the banks these improvements are practically permanent.

During the fiscal year work was continued at White Creek Shoals by extending the longitudinal dam and building a second spur-dam, making the entire length of dam 1,685 feet, with two spurs of 130 feet and 215 feet long, respectively. The result is that the obstructive bar at this point is satisfactorily removed. The channel at Soddy Shoals and vicinity was cleared of surface obstructions, and in June preparations were in progress for deepening the channel, and that work will be commenced in July.

The survey of the Tennessee River from Chattanooga to the junction of the Holston and French Broad rivers, as provided for by act of September 19, 1890, First Lieut. John Biddle, Corps of Engineers, in charge, was commenced at mouth of French Broad River, $4\frac{1}{2}$ miles above Knoxville, and has been continued a distance of 35 miles to Concord, Tenn., which point was reached at the close of the fiscal year.

The snag and tow boat *Weitzel*, having been rebuilt from the appropriation for improving Cumberland River, has been transferred to that stream, and another vessel, the *McPherson*, purchased for use on the Upper Tennessee and its tributaries. This steamer has been employed in towing quarter-boats, etc., from Chattanooga to the mouth of the French Broad for the survey party, and barges from winter quarters at Soddy Creek to Bryant Shoals, French Broad River, for the purpose of resuming operations at that obstruction.

Amount expended during the fiscal year, including outstanding indebtedness, was $17,210.77, as follows:

General improvement	$12,391.37
Survey from Chattanooga to junction of Holston and French Broad rivers	4,819.40
July 1, 1890, balance unexpended	4,319.44
Amount appropriated by act approved September 19, 1890	30,000.00
	34,319.44
June 30, 1891, amount expended during fiscal year	14,800.74
July 1, 1891, balance unexpended	19,518.70
July 1, 1891, outstanding liabilities	2,410.03
July 1, 1891, balance available	17,108.67
Amount (estimated) required for completion of existing project	69,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	69,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(*b*) *Below Bee Tree Shoals, Alabama* (*225 miles*).—This section of the river is generally navigable during the greater part of the year, though certain obstructions render navigation difficult during the low-water season.

The principal obstructions are met at Big Bend Shoals, Wolf Island Shoal, Beech Creek Shoals, Duck River Shoals, Johnsonville Bar, and several others of minor importance.

The character of the work required is the removal of loose and solid rock, sand and gravel bars, snags, and overhanging trees, and the improvements desired can be made at moderate expenditure. A careful, detailed examination of these several localities and a general instrumental survey of the river below Bee Tree Shoals should be made whereon to base plans and estimates.

The snag-boat *Weitzel* was engaged in November and December in removing surface obstructions from Florence to the mouth of river.

The act of September 19, 1890, provided for the preservation of Livingston Point, Kentucky, which, with two small islands, forms Paducah Harbor at the mouth of the river. The work of revetting the wearing slopes of the point and a construction of a pile and stone dike was contracted for March 30, 1891, and the work is progressing satisfactorily.

Nine hundred and thirty-four cubic yards of stone and 210 cords of brush were used for bank protection, and 358 piles, 55 waling pieces, 62 iron rods, 1,125 cubic yards of stone, and 303½ cords of brush were used in dike construction.

The amount expended during the fiscal year, including outstanding indebtedness not covered by contract, was $1,327.21.

The money statement is included in that for improvement of Tennessee River below Chattanooga, page 287.

(See Appendix E E 1.)

2. *Hiawassee River, Tennessee.*—This stream enters the Tennessee River about 38 miles above Chattanooga. On examination in 1874 it was found to be obstructed by rock-reefs, gravel-bars, snags, and overhanging trees.

The present project consists in the deepening of the channel by excavation, and the construction of wing-dams so as to secure a navigable channel 40 feet wide and 2 feet deep at average low water, as high up as Savannah Ford—a distance of about 43 miles—and the removal of all snags, bowlders, overhanging trees, and other surface obstructions.

The amount expended to June 30, 1890, including outstanding indebtedness, was $34,971.95, and has resulted in clearing and improving the channel of the river to a limited degree, at some thirteen of the principal obstructions. The appropriations have been too small to allow of extended plans for any radical improvement. No work was done nor disbursements made during the fiscal year.

The work of clearing the channel of surface obstructions and repairing the wing-dams will be resumed as soon as practicable.

July 1, 1890, balance unexpended	$86.51
Amount appropriated by act approved September 19, 1890	1,500.00
July 1, 1891, balance unexpended	1,586.51
July 1, 1891, outstanding liabilities	38.04
July 1, 1891, balance available	1,548.47

(See Appendix E E 2.)

3. *French Broad River, Tennessee.*—This stream rises on the western slopes of the Blue Ridge in North Carolina, and enters the State of Tennessee at Paint Rock, and after a course of 121 miles in that State joins the Holston about 5 miles above Knoxville, thus forming the Tennessee River.

By examinations made in 1871 and 1875, the river was found to be obstructed by rock-reefs, sand and gravel bars, and surface obstructions such as bowlders, snags, and overhanging trees. It was not deemed feasible to improve the river above Leadvale, but from this point to the mouth—a distance of about 90 miles—it is projected to remove all surface obstructions, and by excavation and the use of wing-dams to secure for this distance a channel depth of 2½ feet at ordinary low water. Above the mouth of Nolichucky River (Leadvale) to the boundary line of Tennessee and North Carolina, a system of locks and dams is the

only feasible improvement, but the amount of commerce does not warrant the expenditure.

The amount expended June 30, 1890, was $37,435.56, thereby securing a marked improvement at ten of the principal shoals, especially at Seven Island Shoals, making up-stream navigation at that point possible at lower stages of the river than heretofore. A general deepening of the channel from 6 to 10 inches has been obtained and the channel cleared of snags and other surface obstructions.

The steamer *McPherson* was purchased and paid for, in part, for use upon this stream.

In May preparations were made for renewing operations at Bryant Shoals, and in June 195 cubic yards of loose rock was removed from channel, and 495 cubic yards of stone quarried, and 195 cubic yards of riprap dam built at that obstruction.

The amount expended during the fiscal year, including outstanding indebtedness, was $4,027.05.

July 1, 1890, balance unexpended	$725.94
Amount appropriated by act approved September 19, 1890	10,000.00
	10,725.94
June 30, 1891, amount expended during fiscal year	2,580.48
July 1, 1891, balance unexpended	8,145.46
July 1, 1891, outstanding liabilities	1,446.57
July 1, 1891, balance available	6,698.89
Amount (estimated) required for completion of existing project	102,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix E E 3.)

4. *Clinch River, Tennessee.*—This stream rises in the Cumberland Mountains in Virginia, and after following a southwesterly course for about 400 miles, empties into the Tennessee River at Kingston, about 110 miles above Chattanooga. About 230 miles of the river flows through the State of Tennessee.

An examination of this river was made in 1875, when the channel was found to be very crooked, and obstructed by sand and gravel bars, by rough rock-reefs, and the surface obstructions usually found in mountain streams. It is deemed feasible to improve about 145 miles of its course in Tennessee by channel excavation and wing-dams, and the removal of such logs and overhanging trees, from time to time, as may prove obstructions to navigation.

The present project consists in channel excavation, building wing-dams, and removing surface obstructions, so as to obtain a safe, navigable channel of 2 feet depth at average low water from its mouth to Clinton—72 miles—and of 1½ feet from Clinton to Haynes (Walker Ferry), about 75 miles.

The amount expended to June 30, 1890, including outstanding indebtedness, was $31,000, which has resulted in clearing the channel of surface obstructions and in securing a longer period of safe navigation for flatboats and rafts.

Active operations were resumed in June at Llewellyn Shoals, making necessary repairs of plant and temporary quarters. Forty cubic yards of stone was placed in dam, and two snags removed from channel.

The amount expended during the fiscal year, including outstanding indebtedness, was $978.14.

July 1, 1890, balance unexpended	$14.05
Amount appropriated by act approved September 19, 1890	4,000.00
	4,014.05
June 30, 1891, amount expended during fiscal year	503.35
July 1, 1891, balance unexpended	3,510.70
July 1, 1891, outstanding liabilities	474.79
July 1, 1891, balance available	3,035.91
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix E E 4.)

5. *Cumberland River, Tennessee and Kentucky.*—(*a*) *Below Nashville.*—The present project for improving this portion of the river is based on an examination made in 1871. The obstructions were found to be of the same general character throughout, consisting of rock-reefs, sand and gravel bars, bowlders, snags, and overhanging trees, and other surface obstructions. This project comprises the deepening of the channel by excavation and the use of wing-dams; the removal of snags and surface obstructions, and the modifying of the channel in the Kentucky Chute of the Ohio, at the mouth of the Cumberland, by the construction of a pile-dike with crib superstructure.

The total amount expended to June 30, 1890, including outstanding indebtedness, was $262,061.16, and has resulted in obtaining an increased depth at low water at the worst obstructions, thus securing a lengthened season of navigation.

The amount expended during the fiscal year, including outstanding indebtedness, was $5,498.65: for general improvement, $5,366.38; for "at mouth of river," $132.27; the work done being reducing the gravel-bar, modifying the longitudinal dam and building new spur rip-rap dam at Catlin Shoals; rebuilding the United States snag-boat *Weitzel*, and in clearing the channel of snags and overhanging trees between Smithland and Nashville, in January, as far as practicable. Payments for watching United States engineer property and contingent authorized expenses formed a part of the above expenditures.

If the project to canalize the Lower Cumberland be adopted and provided for, the engineer officer in charge urges the advantage of immediately constructing the first lock at Harpeth Shoals, which is still a formidable obstruction to navigation and in need of radical improvement.

July 1, 1890, balance unexpended		$3,241.55
Amount appropriated by act approved September 19, 1890		40,000.00
		43,241.55
June 30, 1891, amount expended during fiscal year		4,500.56
July 1, 1891, balance enexpended		38,740.99
July 1, 1891, outstanding liabilities	$998.09	
July 1, 1891, amount covered by uncompleted contracts	16,979.00	
		17,977.09
July 1, 1891, balance available		20,763.90
Amount (estimated) required for completion of existing project		193,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		193,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(*b*) *Above Nashville.*—The present project provides for the complete canalization of the river from Nashville to head of Smith Shoals, a distance of 337 miles. The project is based on an instrumental survey made in 1883, the estimates as approved covering the construction of thirty locks and dams, at an aggregate cost of $4,077,922, which estimate is now revised and increased to $7,500,000 by the engineer officer in charge for the reason that locks of larger dimensions have been adopted than were originally estimated for.

The amount expended on account of locks and dams, including outstanding indebtedness, to June 30, 1890, was $47,762.13, which sum was applied to payments for purchases of sites, construction of lock-keepers' house, work at Lock No. 1, and the contingencies pertaininging to operation under the new project. Fifty thousand dollars appropriated by act of July 5, 1884, had been expended in channel work, building wing-dams, and the removal of surface obstructions.

At Lock No. 1 the work of construction was carried on under contract during the first four months of the fiscal year, but in November high water caused a total suspension until May, when work was again resumed. A second contract was entered into October 17, 1890, for the completion of the lock masonry.

The Board of Engineer Officers constituted for the consideration of the projected dam at Lock No. 1, having withdrawn their contingent approval of a bear-trap dam, submitted a recommendation for a fixed dam, which has been approved. A contract for building the abutment of this dam was entered into May 30, 1891. Provision will be made for building the dam as soon as the lock-work is sufficiently advanced.

At Lock 2, the lock site was bought in 1889 and the site of the abutment of the dam was acquired by condemnation on May 2, 1891. Contract was entered into February 24, 1891, for the masonry of the lock, complete, including cofferdam and necessary excavation for foundation. The construction of the cofferdam was progressing at the close of the fiscal year.

The amount expended, including outstanding indebtedness, during the fiscal year was $31,680.26.

The United States snag boat *Weitzel* was employed in the channel since January, snagging, reducing sand bars, etc., by virtue of the act of September 19, 1890, providing for the expenditure upon such work "above Nashville" of $5,000 of the act of August 2, 1882, remaining in the Treasury to the credit of the appropriation for improving Cumberland River above mouth of the Jellico, Kentucky.

Good work was done at more than seventy places between Burnside and Double Island, a distance of about 276 miles, and costing $4,189.98, including outstanding indebtedness.

July 1, 1890, balance unexpended		$229,539.81
Amount appropriated by act approved September 19, 1890		250,000.00
		479,539.81
June 30, 1891, amount expended during fiscal year		31,221.21
July 1, 1891, balance unexpended		448,318.60
July 1, 1891, outstanding liabilities	$459.05	
July 1, 1891, amount covered by uncompleted contracts	231,207.84	
		231,666.89
July 1, 1891, balance available		216,651.71

Amount (estimated) required for completion of existing project	$6,975,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(c) *Above mouth of the Jellico, Kentucky.*—In accordance with the provisions of the act of September 19, 1890, $3,374.46 of the appropriation of August 2, 1882, has been expended in the removal of snags and sand bars in the Cumberland River above Nashville.

July 1, 1890, balance unexpended, and made available by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	3,374.46
July 1, 1891, balance unexpended	1,625.54
July 1, 1891, outstanding liabilities	815.52
July 1, 1891, balance available	810.02

(See Appendix E E 5.)

6. *Caney Fork River, Tennessee.*—This stream, after a course of about 200 miles wholly in the State of Tennessee, empties into the Cumberland River at Carthage, Tenn., about 116 miles above Nashville, Tenn. It is one of the most important branches of the Cumberland River.

Examinations were made in 1879 as high up as Sligo Ford, about 72 miles, and in 1886 it was extended 20 miles farther to Frank Ferry, the head of navigation.

The present project is to improve the river below Frank Ferry 92 miles, by removing drift and other surface obstructions, and in building the wing dams and training walls necessary to insure safe navigation for small steamboats and flatboats during the boating season, usually about 5 months in duration, from February to July.

The amount expended to June 30, 1890, including outstanding indebtedness, was $22,441.99, which was used in removing surface obstructions, in reducing sand and gravel bars, and in repairing and building dams. The channel from Sligo Ford to mouth of river has been greatly improved at a 3-foot stage above low water, especially at Trousdale Ferry and Chandler Island.

In June work was carried on in the channel from Frank Ferry to Mine Lick Shoals, a distance of about 37 miles. Eight fish-trap dams, 49 snags, and 439 cubic yards of rock were removed, and 4,787 overhanging trees cut down. A dam 75 feet long was built at Darkey Eddy Islands.

Amount expended, including outstanding indebtedness during the fiscal year, was $930.50.

July 1, 1890, balance unexpended	$77.01
Amount appropriated by act approved September 19, 1890	2,500.00
	2,577.01
June 30, 1891, amount expended during fiscal year	41.77
July 1, 1891, balance unexpended	2,535.24
July 1, 1891, outstanding liabilities	888.73
July 1, 1891, balance available	1,646.51

Amount (estimated) required for completion of existing project	20,228.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,228.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix E E 6.)

7. *South Fork of Cumberland River, Kentucky.*—This stream empties into the Cumberland River near Burnside, Ky., about 325 miles above Nashville.

By an examination made in 1880 its upper waters were found to be so obstructed by immense sandstone bowlders as to render its improvement impracticable. For a distance of about 44 miles, from its mouth to Devil Jumps, however, it was considered practicable to improve the channel by deepening the water on the sand and gravel bars by the use of wing dams and the removal of surface obstructions.

The present project provides for this improvement to an extent that will allow of safe navigation for flatboats and rafts at a 3-foot stage above low water.

The amount expended to June 30, 1891, was $11,968.94, which has resulted in obtaining safer navigation for rafts, etc., for a distance of 16 miles above its mouth. No expenditures were made during the fiscal year ending June 30, 1891.

July 1, 1890, balance unexpended	$41.03
July 1, 1891, balance unexpended	41.03
July 1, 1891, outstanding liabilities	9.97
July 1, 1891, balance available	31.06
Amount (estimated) required for completion of existing project	50,803.00
Amount that can be profitably expended in fiscal year ending June 30,1893	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix E E 7.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Barlow, and reports thereon submitted. It is the opinion of Lieutenant-Colonel Barlow, based upon the facts and reasons given that these localities are not worthy of improvement. This opinion being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Little Pigeon River, Tennessee, from mouth to Sevierville.*—Printed as House Ex. Doc. No. 159. (See also Appendix E E 8.)

2. *Harbor of Smithland, Kentucky.*—Printed as House Ex. Doc. No. 107. . (See also Appendix E E 9.)

The required preliminary examination of *Obion River, Tennessee, from its mouth to the crossing of the Louisville and Memphis Railroad in Obion County*, was made by the local engineer in charge, Lieutenant-Colonel Barlow, and report thereon submitted. It is the opinion of Lieutenant-Colonel Barlow, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Lieutenant-Colonel Barlow was charged with and has completed its survey and submitted report thereon. The improvement proposed contemplates the formation of a navigable channel not less than 3 feet deep at the lowest stages, by clearing the river of obstructions and snags, constructing dams, etc.; the cost of the work is estimated at $50,000, including plant for snagging and pile-driving. (See Appendix E E 10.)

IMPROVEMENT OF TENNESSEE RIVER BETWEEN CHATTANOOGA, TENNESSEE, AND FOOT OF BEE TREE SHOALS, ALABAMA.

Officers in charge, Lieut. Col. J. W. Barlow, Corps of Engineers, to March 18, 1891, with Lieut. Geo. W. Goethals, Corps of Engineers, under his immediate orders; and Lieut. Geo. W. Goethals, Corps of Engineers, since that date; Division Engineer, Col. C. B. Comstock, Corps of Engineers, since April 3, 1891.

1. *Tennessee River between Chattanooga, Tennessee, and foot of Bee Tree Shoals, Alabama.*—The original condition of the river from Chattanooga to Brown's Ferry, when examined in 1867 and subsequently, was found to be obstructed by rock reefs, bars, bowlders, and projecting rocky points, permitting navigation from 6 to 9 months in the year. From Brown's Ferry to Florence it was not navigable except at unusually high water stages because of the Muscle Shoals obstructions. From Florence to Riverton, Colbert and Bee Tree Shoals limited navgation to about 6 months in the year.

The present project consists in:

(*a*) Removing obstructions by blasting and dredging in "The Suck" and at Bridgeport and Guntersville, Ala.

(*b*) Building a canal 14.5 miles long, 70 to 120 feet wide, and 6 feet deep around the Big Muscle Shoals, having 9 locks, each 60 by 300 feet, and an aqueduct over Shoal Creek 900 feet long and 60 feet wide; constructing a canal 1.5 miles long with 2 locks around Elk River Shoals.

(*c*) Blasting a channel through bed rock and building wing dams at Little Muscle Shoals; as modified in 1890, the project contemplates the building of a canal along the south bank, 3 miles long, with 2 locks.

(*d*) Constructing a canal 7.8 miles long, 150 feet wide and 7 feet deep, around Colbert and Bee Tree Shoals, with a combined lock at lower end and guard lock at the head; size of locks, 80 by 350 feet.

The total amount expended to June 30, 1890, including outstanding liabilities, was $3,180,876.99, and has resulted in the improvement of the river as follows:

Navigation was made easier through the "Suck" and "Pan" by removal of bowlders, detached rock, overhanging trees, and projecting rocky points. At Elk River Shoals and Big Muscle Shoals the locks, gates, valves, and machinery for properly operating them were completed, the aqueduct and permanent stone dams finished, the canal trunk nearly in condition to permit its use for navigation. At Little Muscle Shoals the channel was excavated and the wing dams built as originally projected. At Colbert and Bee Tree Shoals an increased depth was obtained by channel excavation and building stone dams to contract water-way.

The amount expended during the fiscal year, including outstanding liabilities, was $176,662.35, for which the following work was done:

At the "Suck."—A survey party was organized, the necessary instruments and outfit purchased, and the field work begun.

At Elk River Shoals.—The construction of a drift sluice in the longitudinal dam above Lock A, to be operated by the Parker automatic gate, was begun and is well under way; a portion of the dam was raised to the level of the lock walls. At Lock A the hydraulic machinery was slightly modified, the filling behind both walls completed, and an office built. Below Lock B the channel was deepened and straightened by dredging and removing bowlders from Gilchrist Chute and Nance's Reef. Land was purchased at both locks as sites for lock-keepers' houses.

At Big Muscle Shoals.—The dam across Second Creek was extended

30 feet and another span added to the bridge. Trussed fenders were built on both sides of the aqueduct along its entire length. The canal below Lock 7 was widened 30 feet by blasting off a projecting bluff; the stone thus obtained was used to strengthen and tighten the embankment between Locks 7 and 8. The timber revetment at Lock 8 was completed. The cast-iron miter gears on the shafts of the drop gates were replaced by new ones of cast steel. About 9,000 cubic yards of sediment was removed from various levels, reducing them to proper grade. The railway along the towpath was rebuilt for a distance of 9.5 miles, and two new locomotives purchased. Seven thousand three hundred and thirty-six cubic yards of riprap stone was quarried at Lock 4 for paving the inner slope of the canal embankment. Land for lock-keepers' houses was purchased at Locks 3, 4, and 6. The house for assistant engineer at Lock 6 was practically finished, and foundations for three lock-keepers' houses were completed or under way. A contract was made for a Bucyrus dredge for use in the canal.

Having completed the necessary repairs and detailed work required to operate it, the Muscle Shoals Canal was opened to navigation on November 10, 1890.

At Little Muscle Shoals.—Plans and estimates for the radical improvement of this portion of the river were submitted to a Board of Engineer officers in October, 1890, and on their recommendation the project was modified as given above.

At Colbert and Bee Tree Shoals.—The project for the lateral canal, as recommended by a Board of Engineer officers, was approved, and the survey for location of the proposed canal was begun; 4.5 miles of the line were finished, including borings and examinations of rock for lock foundations.

The money statement for this work is consolidated with that for Tennessee River below Bee Tree Shoals, page 279, so as to embrace the entire reach of the river below Chattanooga, as follows:

Tennessee River below Chattanooga.

July 1, 1890, balance unexpended		$35,501.30
Transfer settlements 5712, 5740 and 6023		3.91
Amount appropriated by act approved September 19, 1890		475,000.00
		510,505.21
June 30, 1891, amount expended during fiscal year		160,619.65
July 1, 1891, balance unexpended		349,885.56
July 1, 1891, outstanding liabilities	$17,369.91	
July 1, 1891, amount covered by uncompleted contracts	27,585.60	
		44,955.51
July 1, 1891, balance available		304,930.05
Amount (estimated) required for completion of existing project		5,565,762.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		2,155,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix F F 1.)

2. *Operating and care of Muscle Shoals Canal, Tennessee River.*—The canal was opened November 10, 1890, and has since been in regular use. The number of steamboats, barges, and miscellaneous craft, exclusive of Government boats engaged on the work, that passed through from the time of opening to the end of the fiscal year was 52.

The total expenses incurred during the year were $16,792.04. Estimated expenses for 1891–'92, $55,000.
(See Appendix F F 2.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *mouth of Gunter's Creek at Guntersville, Alabama, with the view of ascertaining the practicability and approximate cost of so improving the same as to secure a safe landing above high water mark*, was made by the local engineer in charge, Lieutenant-Colonel Barlow, and report thereon submitted. It is the opinion of Lieutenant-Colonel Barlow, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 132, Fifty-first Congress, second session. (See also Appendix F F 3.)

IMPROVEMENT OF OHIO, MONONGAHELA, CHEAT, ALLEGHENY, AND MUSKINGUM RIVERS; CONSTRUCTION OF ICE-HARBOR AT MOUTH OF MUSKINGUM RIVER, OHIO.

Officer in charge, Lieut. Col. Wm. E. Merrill, Corps of Engineers, with Lieut. Cassius E. Gillette, Corps of Engineers, under his immediate orders.

1. *Ohio River.*—The general method followed in improving the navigation of the Ohio River is to secure additional depth at islands and sand bars by the construction of low dams across unused passages, and by building guiding dikes where the river is so wide and shoal as to make it necessary to confine the current to a smaller cross section. The radical improvement of the river by movable dams has been begun by the construction of one movable dam at Davis Island, 5 miles below Pittsburg, and another is about to be begun near Beaver, 29½ miles below Pittsburg. A snag boat and two dredges, all of them having iron hulls and owned by the United States, find constant employment in taking out snags and wrecks, and in dredging away gravel and rock bars that can not otherwise be removed.

The first appropriation for the improvement of the Ohio River was made in 1827, and the total sum thus far appropriated for "Ohio River" is $5,790,000. This total includes the appropriations for the movable dams at Davis Island and Beaver, but it does not include the appropriations for "Falls of the Ohio." In addition to these direct appropriations, a portion of several combined appropriations for the Mississippi, Missouri, Ohio, and Arkansas rivers, aggregating $1,997,040.68, was expended on the Ohio River.

The following is a summary of the work done during the fiscal year. The unusual high water that prevailed throughout the working season was very detrimental to all river work.

Dam between Davis and Neville Islands.—The cut around the lower end of the dam was stopped by a high abutment, and minor repairs were made on the back slope, some of the paving of which had been washed out.

Dike at the trap.—Some minor repairs were made on the lower slope of the dike, and some decayed timbers were renewed.

Dam at Marietta Island.—The break in the dam was closed, and the dam was completed in December. After the spring floods had subsided

it became necessary to repair the lower slope, where some filling had washed out.

Dike at foot of Marietta Island.—A contract has been let for rebuilding the old dike, but work has not yet been begun.

Dam at head of Blennerhassett Island.—A contract has been let for rebuilding the old dam at this place, and part of the island abutment has been completed.

Dike at Eight Mile Island.—This dike is substantially completed, but the small amount of work yet to be done to carry out the contract had to be laid over on account of continued high water.

Dike at Bonanza Bar.—This dike has been completed. Its effect on the channel has been very satisfactory.

Dike at Cullum.—This dike was let last February and the work has been fairly started.

Dike at lower bar at Rising Sun.—This dike was also let last February, and work on it has just begun.

Dike at Madison.—This dike has been extended to full length, but the stone filling is yet incomplete. No work has been done on the superstructure.

Dike at Flint Island.—The contract for this dike was let in February, and at the close of the fiscal year it extended into the river about one-fourth of its intended length.

Dike at Caseyville.—The work is completed as far as now contracted for. At some future date a timber cap should be placed on the existing substructure.

Dike at middle of Grand Chain.—No extension of the dike was possible during the fiscal year on account of continued high water.

Rock bar at mouth of Licking.—The contractor abandoned his contract after making a start. Throughout the remainder of the working season the river remained too high to do anything.

Ice-pier at Kerr Run.—The contract was only let in May and nothing has yet been done.

Ice-pier at Portsmouth.—Three sections of this pier have been completed. The contract for the fourth section was let in May and work has not yet been begun.

Ice-pier at Ripley.—The contract for this pier was also let in May and the work of construction has not yet been begun.

Great Miami embankment.—The work of raising the track of the Ohio and Mississippi Railroad, where it crosses the embankment, has been completed, and a contract has been let for extending the embankment to its junction with the Cleveland, Cincinnati, Chicago and St. Louis Railroad.

Embankment at Shawneetown.—The work of strengthening this embankment with earth has been completed, and the next step will be to contract for protecting it with riprap and paving.

July 1, 1890, balance unexpended		$136,648.06
Amount appropriated by act approved September 19, 1890		300,000.00
		436,648.06
June 30, 1891, amount expended during fiscal year		119,590.96
July 1, 1891, balance unexpended		317,057.10
July 1, 1891, outstanding liabilities	9,240.86	
July 1, 1891, amount covered by uncompleted contracts	169,579.29	
		178,820.15
July 1, 1891, balance available		138,236.95

Amount that can be profitably expended in fiscal year ending June 30, 1893 $706,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix G G 1.)

2. *Operating snag boats on Ohio River.*—During 1890 the snag boat *E. A. Woodruff* worked from September 13 to November 24. The river was too high for satisfactory work, but she removed 204 snags, 3 steamboat wrecks, 11 sunken coal boats and barges, 2 flats, and 1 wharf boat. The total distance traveled was 2,641 miles.

(See Appendix G G 2.)

3. *Operating and care of Davis Island Dam, Ohio River.*—This dam was built to test the adaptability of the system of movable dams to the peculiar conditions of the Ohio River, and to the special character of the commerce that navigates it. It was intended to be the first step in the radical improvement of the Ohio River, designed to give a minimum depth of 6 feet at all times except when ice was running. Incidentally this dam has been of great value to the city of Pittsburg by securing an ample depth of water in its harbor throughout the low-water season. It has also been of immense benefit to the coal trade by enabling them to bring loaded boats out of the Monongahela River at any time. The natural harbor room of Pittsburg is very limited, and before the Davis Island Dam was built the great bulk of coal barges were held in the Monongahela. In short rises the amount of coal that could be shipped south was absolutely limited by the number of barges that could be locked through the lowest dam in the Monongahela during the passage of the rise. Under present conditions this limit no longer exists, and all coal can now be shipped for which towboats are available.

The past fiscal year was a remarkably wet one, and the dam was only up 82 days.

A heavy scour that developed below the dam was stopped by piling, sunken boats, and stone.

(See Appendix G G 3.)

4. *Movable dam in Ohio River near mouth of Beaver River, Pennsylvania.*—The first appropriation for this work was made September 19, 1890. During the fiscal year a definite site has been selected for this work, drawings have been prepared, and condemnation proceedings have been instituted to obtain the land required on both sides of the river. Until the site is secured the work of construction can not be begun.

Amount appropriated by act approved September 19, 1890	$250,000.00
June 30, 1891, amount expended during fiscal year	1,381.23
July 1, 1891, balance unexpended	248,618.77
Amount (estimated) for completion of existing project	650,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	250,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix G G 4.)

5. *Monongahela River, West Virginia and Pennsylvania.*—The 7 lower locks and dams on the Monongahela River belong to the Monongahela Navigation Company, and they create slack-water from Pittsburg to Dunkard Creek, a distance of 88 miles. Locks and Dams Nos. 8 and

9, belonging to the United States, continue this slack-water to Morgantown, W. Va., a further distance of 14 miles, the distance from Pittsburg to Morgantown being 102 miles.

During the past year 2 lock-keepers' houses were built, the guiding crib below the land wall was raised and extended into the bank, and some minor repairs were made.

July 1, 1890, balance unexpended	$15,917.20
June 30, 1891, amount expended during fiscal year	15,115.54
July 1, 1891, balance unexpended	801.66
July 1, 1891, outstanding liabilities	49.53
July 1, 1891, balance available	752.13

(See Appendix G G 5.)

6. *Operating and care of Locks and Dams Nos. 8 and 9, Monongahela River.*—There has been no stoppage to navigation throughout the year. The channel below No. 8, which had become shoal, was deepened by dredging. At Lock 9 the raising of the lock walls was completed. A bar thrown up in the winter against the lower end of Lock 8, obstructing the lower turbine well of the river wall, was removed by one of the United States dredges, and the same boat deepened the channel above and below Lock 9.

The aprons of both dams were injured by floods, but the continued high water made it impossible to repair them. Some minor changes were made in the operating machinery on the lock, which have improved its efficiency.

(See Appendix G G 6.)

7. *Purchase of Lock and Dam No. 7, Monongahela River.*—The case of The United States *vs.* The Monongahela Navigation Company for the condemnation of this structure, was heard in the circuit court of the United States for the western district of Pennsylvania in November last, and the value of the work was fixed by the court at $209,000. The navigation company took an appeal to the Supreme Court of the United States, where the matter is now pending.

July 1, 1890, balance unexpended, appropriation for costs of condemnation of Lock and Dam No. 7, Monongahela River	$3,533.87
June 30, 1891, amount expended during fiscal year	3,431.55
July 1, 1891, balance unexpended	102.32

(See Appendix G G 7.)

8. *Purchase of Lock and Dam No. 6, Monongahela River.*—Under the act of Congress no steps can be taken towards the condemnation of this lock and dam until the United States has acquired title to Lock and Dam No. 7.

Appropriation by act of September 19, 1890—	
For purchase of Lock and Dam No. 6	$162,000
For costs of condemnation of Lock and Dam No. 6	5,000

(See Appendix G G 8.)

9. *Cheat River, West Virginia.*—The object proposed on this river is to remove the rocks that obstruct the floating of timber, in order to bring into market the vast forests that lie on the headwaters of this stream. The length of obstructed river is 30 miles, and it is limited to the lower part of the stream, where it breaks through Laurel Ridge. Four months of work has been done, and about one-third of this part of the river has been made passable.

Amount appropriated by act approved September 19, 1890	$13,000.00
June 30, 1891, amount expended during fiscal year	5,108.15
July 1, 1891, balance unexpended	7,891.85
July 1, 1891, outstanding liabilities	1,408.35
July 1, 1891, balance available	6,483.50

(See Appendix G G 9.)

10. *Allegheny River, Pennsylvania.*—The work hitherto done on this river has been limited to the removal of rocks, of which there was a vast number in and near the channel, and to the construction of low dams and dikes of crib-work. Much benefit to navigation has resulted.

The money thus far appropriated to the improvement of the Allegheny River amounts to $200,000.

The dam at Cornplanter Islands has been nearly completed, and some minor repairs have been made on the dike at Red Bank. Arrangements have been made to build dams at Hickory and at Pithole Island.

Injunctions have been obtained against parties encroaching on the Allegheny River within the limits of Pittsburg.

July 1, 1890, balance unexpended	$1,708.18
Amount appropriated by act approved September 19, 1890	20,000.00
	21,708.18
June 30, 1891, amount expended during fiscal year	3,108.30
July 1, 1891, balance unexpended	18,599.88
July 1, 1891, outstanding liabilities	835.90
July 1, 1891, balance available	17,763.98
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix G G 10.)

11. *Dam at Herr Island, Allegheny River.*—All the land that seemed to be required for this work on both sides of the river was purchased, and construction was about to begin, when suit was brought in the circuit court of the United States in favor of certain riparian owners who had been supposed to have no claim to compensation; the work of construction has necessarily been held back to await the termination of this suit. Meanwhile the lot purchased on the left bank for a lock-keeper's house has been filled up and the drawings of the work have been carried forward.

In accordance with the request of the authorities of Pittsburg and Allegheny City the Secretary of War has ordered that the dam at Herr Island be made a movable one.

July 1, 1890, balance unexpended	$68,954.69
Amount appropriated by act approved September 19, 1890	35,000.00
	103,954.69
June 30, 1891, amount expended during fiscal year	33,306.46
July 1, 1891, balance unexpended	70,648.23
Amount (estimated) required for completion of existing project	524,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix G G 11.)

12. *Ice-harbor at mouth of Muskingum River, Ohio.*—The work in hand is the construction of a large lock through Dam No. 1, Muskingum River, in order to permit Ohio River craft to take refuge during ice floods in the pool created by this dam. This lock is also needed to replace Lock No. 1 of the Muskingum River, which had become dangerous and has been torn down.

During the past fiscal year the masonry of the river wall and of half of the land wall was completed, and the remainder of the land wall was finished to half of its intended height. The work yet to be done is the completion of the land wall, the erection of the lower gates of the lock, and the establishment of the valves and operating machinery. It is expected that the work will be completed during the fiscal year. It can not be utilized until a new draw is placed in the railroad bridge below the lock. The owners of this bridge have been ordered by the Secretary of War to construct this draw, but thus far they have not done so.

July 1, 1890, balance unexpended	$287.78
Amount appropriated by act approved September 19, 1890	30,000.00
	30,287.78
June 30, 1891, amount expended during fiscal year	10,173.49
July 1, 1891, balance unexpended	20,114.29
July 1, 1891, outstanding liabilities	6,017.23
July 1, 1891, balance available	14,097.06

(See Appendix G G 12.)

13. *Muskingum River, Ohio.*—This appropriation is limited by the act to the construction of a new lock at Taylorsville and the repair of the lock at Zanesville. During the fiscal year the excavation of a channel through the rocky bed of the river below the Taylorsville lock was continued. The frequent floods greatly interfered with this work, which is now about one-fifth completed. The lock can not be used by navigation until a new draw is placed in the Taylorsville and Duncan Falls Bridge. The owners of this bridge have been ordered to build this draw, but thus far they have not complied with the order.

July 1, 1890, balance unexpended	$39,121.33
June 30, 1891, amount expended during fiscal year	3,820.09
July 1, 1891, balance unexpended	35,301.24
July 1, 1891, outstanding liabilities	1,805.80
July 1, 1891, balance available	33,495.44

(See Appendix G G 13.)

14. *Operating and care of locks and dams on Muskingum River, Ohio.*—As originally improved by the State of Ohio, 11 dams and 12 locks were built on the Muskingum River, furnishing continuous navigation for 91 miles from the Ohio River at Marietta to Dresden, where a connection was made with the Ohio Canal near its middle point, this canal extending from the Ohio River at Portsmouth to Lake Erie at Cleveland. According to old reports from the State board of public works, the locks were built with a length between hollow quoins of 180 feet and a clear width of 36 feet, except the upper lock, between Zanesville and Dresden, which had a length of 120 feet and a clear width of 22 feet. The lifts as reported varied from 8 feet 10 inches to 12 feet 1 inch, but measurements made since the United States took charge show that none of the above dimensions were strictly accurate. The works cost the State of Ohio about $1,500,000.

The lock and dam above Zanesville is now in a state of ruin, but the 75 miles of slack-water between the Ohio River and Zanesville has always been maintained; on this piece of river there are 10 dams, 11 locks, and 5 lateral canals with a total length of $3\frac{2}{3}$ miles.

The locks and dams were about worn out when they passed into the hands of the United States, and a general reconstruction was unavoidable. This work was very greatly retarded and increased in cost by the extraordinary rainfall of last summer and autumn, which repeatedly carried away cofferdams and drowned out the work. At the close of the year the reconstruction of Locks 3, 4, and 8 had been completed, but Locks 6 and 7 were yet unfinished. The floods had a very disastrous effect on the dams; Nos. 1, 6, and 8 gave way, and a break took place around the abutment of dam No. 4. The latter has been thoroughly closed, but it was impossible to do anything for the repair of the broken dams.

It is expected that before the close of 1891 the locks will be finished and all breaks repaired. Throughout the year navigation, except some local pool trade, was wholly stopped.

Since the transfer of this work to the United States the sum of $741,863.03 has been expended in reconstruction, operation, and maintenance.

(See Appendix G G 14.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *harbor of Owensboro, Kentucky, on the Ohio River*, was made by the local engineer in charge, Lieutenant-Colonel Merrill, and report thereon submitted. It is the opinion of Lieutenant-Colonel Merrill, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 193, Fifty-first Congress, second session. (See also Appendix G G 15.)

The required preliminary examination of *Tionesta [Creek], Pennsylvania, from the town of Tionesta, to the village of Balltown, with a view to the improvement and the removal of obstructions*, was made by the local engineer in charge, Lieutenant-Colonel Merrill, and report thereon submitted. It is the opinion of Lieutenant-Colonel Merrill, based upon the facts and reasons given, that this locality is worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The improvement proposed contemplates removal, at an estimated cost of $2,000, of the obstructions which interfere with the rafting of timber and lumber. The report was transmitted to Congress and printed as House Ex Doc. No. 196, Fifty-first Congress, second session. (See also Appendix G G 16.)

The required preliminary examination *with a view to improving the Ohio River, between the mouth of Green River, in the State of Kentucky, and the city of Evansville, in the State of Indiana, and confining the waters of the first named river within its present channel, and preventing danger to navigation from any changes therein*, was made by the local engineer in charge, Lieutenant-Colonel Merrill, and report thereon submitted. It is the opinion of Lieutenant-Colonel Merrill, based upon the facts and reasons given, that this locality is worthy of improvement.

The report of the preliminary examination, together with report dated November 16, 1887, of a survey of the locality made in compliance with the provisions of the river and harbor act of August 5, 1886, furnishing all the information required by the act of September 19, 1890, and containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The work proposed to be done to prevent the Ohio River from making a cut-off through the peninsula opposite Evansville consists in planting a strip of land along the axis of the peninsula with trees, the estimated cost of which is $49,000. The reports were transmitted to Congress and printed as House Ex. Doc. No. 195, Fifty-first Congress, second session. (See also Appendix G G 17.)

IMPROVEMENT OF FALLS OF THE OHIO RIVER, OF WABASH RIVER, INDIANA AND ILLINOIS, AND OF WHITE RIVER, INDIANA; OPERATING AND CARE OF LOUISVILLE AND PORTLAND CANAL.

Officers in charge, Capt. Edw. Maguire, Corps of Engineers, to May 25, 1891, and Major G. J. Lydecker, Corps of Engineers, since that date; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Falls of the Ohio River, Louisville, Kentucky.*—The general improvement under the present approved project comprises the enlargement of the upper portion of the Louisville and Portland Canal and the enlargement of the canal basin above the new locks.

Enlargement of the upper portion of the Louisville and Portland Canal.—The present project was adopted in 1883 and modified in 1890, at which time the estimated cost of completing the work recommended by the Board of Engineers was $710,230.40. It includes a large amount of rock excavation, whereby the canal will be widened to more than double its former width for a length of some 2,300 feet, and a capacious basin or harbor, with a width of 800 feet and length of about 3,200 feet, will be formed in advance of the entrance to the canal. Masonry walls and dams, aggregating 5,850 feet in length, are to close the enlarged canal and basin on the river side. The work is being done by hired labor, with machinery owned by the Government.

The amount expended to June 30, 1891, was $389,612.95, of which $22,039.06 was expended during the last fiscal year. The deduction of this amount from the total cost as estimated by the Board of Engineers in January, 1890, viz, $710,230.40, leaves $688,191.34 as the present estimated cost of completing the project for this portion of the work.

Enlargement of the canal basin above the new locks.—This work was by the river and harbor act approved August 5, 1886, made a part of the general improvement of the Falls of the Ohio at Louisville. The object is to construct a large basin wherein large tows may lie securely while waiting their turn to enter the locks, without interfering with navigation through the canal. The principal elements of work involved are the excavation of about 140,000 cubic yards of earth and rock and the construction of about 5,200 cubic yards of masonry retaining wall. The work is being done by hired labor with machinery owned by the Government, the attempt to do it by contract having proved most unsatisfactory.

The amount expended to June 30, 1891, was $76,850.88, of which $6,059.85 was expended during the past fiscal year. The additional amount estimated as necessary for the completion of this work is, in round numbers, $70,000.

Continued high water during the last fiscal year limited the working

season to about 1 month, and thereby prevented any considerable progress on this work, as well as that at the head of the canal.

The estimate for completing the existing project submitted in the statement below includes $688,191.34 for the work at the head of the canal, and $70,000 for that at the basin above the locks, making the total $768,191.34.

July 1, 1890, balance unexpended		$161,635.08
Amount appropriated by act approved September 19, 1890		60,000.00
		221,635.08
June 30, 1891, amount expended during fiscal year		28,488.91
July 1, 1891, balance unexpended		193,146.17
July 1, 1891, outstanding liabilities	$12,018.95	
July 1, 1891, amount covered by uncompleted contracts	14,721.32	
		26,740.27
July 1, 1891, balance available		166,405.90
Amount (estimated) required for completion of existing project		758,191.34
Amount that can be profitably expended in fiscal year ending June 30, 1893		300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix H H 1.)

2. *Indiana Chute, Falls of the Ohio River.*—The object of this improvement is to obtain a channel over the Falls which can be safely navigated by the largest tows when the river is at or above an 8-foot stage by the upper canal gauge, whereby the great loss of time required for the passage of such tows through the canal and locks would be avoided; the principal features of the work include the excavation of about 60,000 cubic yards of rock from the proposed channel, the construction of lateral stone dikes aggregating in length about 3,700 feet, and of a concrete wall about 850 feet long. This chute was originally very crooked and full of dangerous reefs and rocky points; the work already done has cleared the channel of many of these so that a fairly navigable channel at the higher stages of water is secured. No work was done during the past fiscal year because of continuous high water throughout the year, it being impossible to carry on operations with the machinery now on the work except at very low water.

The amount expended to June 30, 1891, is $116,104.30.

July 1, 1890, balance unexpended		$23,885.20
Amount appropriated by act approved September 19, 1890		25,000.00
July 1, 1891, balance unexpended		48,885.20
July 1, 1891, outstanding liabilities		10.50
July 1, 1891, balance available		48,874.70
Amount (estimated) required for completion of existing project		113,610.97
Amount that can be profitably expended in fiscal year ending June 30, 1893		75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix H H 2.)

3. *Operating and care of Louisville and Portland Canal, Kentucky.*—The canal was open to commerce throughout the past fiscal year, except on 79 days, during which it was closed by high water.

Operations during the year included dredging 100,585 cubic yards of mud and sand from the canal and its approaches, the construction of two new scows, the partial construction of two new middle gates for

the new locks, and the necessary repairs of boats, bridges, buildings, and machinery.

The dry dock was occupied for the repairs of boats belonging to private parties during a period of 57 days 18 hours, and for repairs of craft belonging to the work, 20 days.

The total receipts from all sources during the fiscal year were $962.49.

(See Appendix H H 3.)

4. *Wabash River, Indiana and Illinois.*—The improvement of this river is carried on under two separate appropriations, one of which applies to that portion of the river below Vincennes, Ind., and the other to that above.

a. Below Vincennes.—The first appropriation for this work was in 1872, and the project for work aims at securing a 3½-foot low-water channel by excavating through rocky and sandy shoals, constructing dikes and dams to close secondary channels or contract the flow where necessary, removing snags, and the construction of a lock and dam about 2½ miles above Mount Carmel, Ill., for removing the impassable obstructions to navigation extending a distance of about 10 miles, and known as the Grand Rapids.

Operations during the year were chiefly on this lock and dam, though but little progress was made because the appropriation in the river and harbor act approved September 19, 1890, became available too late to be of much use during that season. Contract for all the stone required for the lock and the abutment of the dam were made, and most of it had been delivered at the close of the year. No other work was done during the year beyond the removal of a few dangerous snags, the extension of the Grayville levee 1,750 feet, and the construction of three new spur dikes at the same point.

The appropriation now available will probably suffice to complete the lock and the abutment of the dam, but no advantage can be derived from these works until the dam is built. The estimated cost of the dam is $60,000, and the appropriation of at least this amount is necessary before starting any work on it, because having commenced the work it should be continued to completion without interruption. Shoals and snags constitute serious and in some cases total obstructions to navigation, and not less than $40,000 will remove them.

The amount expended to June 30, 1891, is $258,203.04.

July 1, 1890, balance unexpended		$11,955.34
Amount appropriated by act approved September 19, 1890		60,000.00
		71,955.34
June 30, 1891, amount expended during fiscal year		30,154.57
July 1, 1891, balance unexpended		41,800.77
July 1, 1891, outstanding liabilities	$1,590.54	
July 1, 1891, amount covered by uncompleted contracts	6,541.80	
		8,132.34
July 1, 1891, balance available		33,668.43
Amount (estimated) required for completion of existing project		100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

b. Above Vincennes.—The object of the work and the project for operations are similar to those relating to the river below this place. There was no work done during the past year because there were not sufficient funds on hand at the beginning, and those appropriated by the act ap-

proved September 19, 1890, came too late to be used to advantage. Navigation on this section is greatly obstructed by snags and shoals. With an appropriation of $20,000 it is estimated that all the worst obstructions can be removed, and thereafter an annual expenditure of about $2,500 for the removal of snags would maintain the improvement.

The amount expended on this section to June 30, 1891, is $70,757.74.

July 1, 1890, balance unexpended	$251.78
Amount appropriated by act approved September 19, 1890	5,500.00
	5,751.78
June 30, 1891, amount expended during fiscal year	9.52
July 1, 1891, balance unexpended	5,742.26
July 1, 1891, outstanding liabilities	6.85
July 1, 1891, balance available	5,735.41
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	20,000.00

(See Appendix H H 4.)

5. *White River, Indiana.*—The present project of improvement aims at obtaining a depth of 3½ feet at low water between the mouth of the river and Hazelton, Ill., at which place a railroad bridge formerly constituted a total obstruction to navigation; this bridge has been modified during the past year, and is now provided with a suitable draw. The principal natural obstruction on this portion of the river was a rock ledge about 2½ miles above its mouth, known as Kelly Ripple; a channel has been excavated through the ledge, the excavated material being used to form dikes on the sides of the channel. Some additional excavation at the head of the cut remains to be done in order to complete the improvement.

The river is badly obstructed by snags, which should be removed.

No work was done on the river during the past year because the expenditure of the money available at the beginning was prohibited by law, until the bridges obstructing navigation had been changed so as to be obstructions no longer. The act approved September 19, 1890, removed this restriction, but it was then too late to commence work.

The amount expended to June 30, 1891, is $102,324.68.

July 1, 1890, balance unexpended	$5,205.66
June 30, 1891, amount expended during fiscal year	30.34
July 1, 1891, balance unexpended	5,175.32
Amount (estimated) required for completion of existing project	12,500.00
Amount thatcan be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	12,500.00

(See Appendix H H 5.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Wabash River, Indiana, from Terra [Terre] Haute to La Fayette with a view of removing obstructions of snags and bars and reëstablishing the navigation of said river between these cities*, was made by the local engineer in charge, Captain

Maguire, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Captain Maguire, and of the Division Engineer, based upon the facts and reasons given, that this locality is not worthy of improvement. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 65, Fifty-first Congress, second session. (See also Appendix H H 6.)

IMPROVEMENT OF GREAT KANAWHA, ELK, AND GAULEY RIVERS, WEST VIRGINIA, AND OF NEW RIVER, VIRGINIA AND WEST VIRGINIA.

Officer in charge, Col. Wm. P. Craighill, Corps of Engineers.

1. *Great Kanawha River, West Virginia.*—This river flows through a fertile and picturesque region, filled with mineral wealth, especially coal and salt. It is by nature divided into a number of pools, some of considerable length and depth, separated by shoals of gravel and coarse sand, which were the principal obstructions to navigation in low water, there being often on them at such seasons but a few inches of water. In some of the pools were found shallow places, also obstructing navigation. There were also snags and loose rocks in the channel. The navigation above Charleston was more obstructed than below. Above it was almost suspended in summer.

The coal and salt were generally sent out on rises, which enabled the boats to pass safely over the obstructions that otherwise would stop their movements entirely. The use of the river for the movement of these valuable products was therefore unsatisfactory and intermittent. By the agency and superintendence of a Board acting under the State, first of Virginia and then of West Virginia, considerable improvement in the river was from time to time effected, tolls being charged on the commerce for the payment of expenses.

The object of the improvement begun several years ago by the United States was to give a constant navigable depth of at least 6 feet throughout the whole length of the Kanawha to its mouth at the Ohio River, to be accomplished by large locks and dams.

Those already built have been about 300 by 50 feet above Charleston and about 340 by 55 below.

The peculiarity of most of the dams is that they can be lowered when the stage of the water in the river will suffice over the shoals. This gives them the name of "movable dams," and enables an open river to be had when the water is high enough.

Dams 3 and 2 above Paint Creek are fixed, as the declivity of the river in that section is too great to permit the advantageous use of the movable system.

Up to June 30, 1890, the amount expended was $2,046,775.42. At that date the finished works were locks and dams 2, 3, 4, 5, and 6.

An appropriation of $300,000 was made September 19, 1890.

The following list of contracts indicates in a summary manner the principal work in progress during the fiscal year:

Contract dated November 26, 1888, with Carkin, Stickney & Cram, for building Lock No. 7, to be completed November 1, 1891.

Contract with C. Irwin McDonald, dated August 20, 1889, for building Lock No. 8, to be completed November 22, 1891.

Contract with Munford & Reynolds, dated December 29, 1890, for the foundations of Dam No. 7, or immovable parts of the navigation pass

and weir, and of a central pier and an abutment with shore crib and bank protection, to be completed December 31, 1891.

Contract with C. Irwin McDonald, dated March 3, 1891, for the foundations of Dam No. 8, or immovable parts of the navigation pass and weir, and of a central pier and an abutment with shore crib and bank protection, to be completed December 31, 1891.

The amount expended in the year ending June 30, 1891, exclusive of outstanding liabilities, was $135,895.23.

Had funds been available, all the locks and dams needed for this improvement could have been begun at the same time and finished in 3 years with much economy to the United States and with manifest advantage in the use of the improved water-way. The development of commerce on this river has been very great since the improvement by the United States, although the project has as yet been only partially executed for want of money.

During the seasons of low water the value of the improvement is shown in a very marked manner, as free and sufficient navigation is then easily maintained over the improved part of the river while navigation may be entirely suspended below the lowest dam and above the upper pool.

July 1, 1890, balance unexpended		$250,370.25
Amount appropriated by act approved September 19, 1890		300,000.00
		550,370.25
June 30, 1891, amount expended during fiscal year		135,895.23
July 1, 1891, balance unexpended		414,475.02
July 1, 1891, outstanding liabilities	$4,000.00	
July 1, 1891, amount covered by uncompleted contracts	346,349.19	
		350,349.19
July 1, 1891, balance available		64,125.83
Amount (estimated) required for completion of existing project		670,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I I 1.)

2. *Operating and care of locks and dams on Great Kanawha River, West Virginia.*—The amount expended during the fiscal year ending June 30, 1891, has been $23,835.57.

(See Appendix I I 2.)

3. *Elk River, West Virginia.*—The Elk is one of the chief tributaries of the Great Kanawha. Its course is tortuous, but the country through which it flows is rich in minerals and well fitted for agriculture and grazing.

The average low-water width is about 200 feet, with narrows at the rapids of about 150 feet in width and occasional portions of about 300 feet in width. The pools vary in depth from 3 to 10 feet, and are separated by rapids over shoals of cobblestones and gravel, on which there has been at low seasons a depth of but a few inches of water. The average fall per mile in the river from Braxton Court House down is about 2½ feet, but is not uniformly distributed, being greatest (about 4 feet per mile) in the central section and less (about 2 feet) in the upper and lower sections. Freshets of small height are of frequent occurrence, but rapidly pass off. The annual rise in the spring is about 10 or 12 feet. An extraordinary rise is sometimes had of 25 to 30 feet, but the duration is not great.

The approved project of improvement has been the removal of rocks, snags, overhanging trees, etc., and the cutting of narrow sluices through the rapids and shoals. The principal interests to be served are those of lumbering and rafting, but much country produce is also carrried down stream in small boats, which return with merchandise, etc.

The first appropriation was in June, 1878. The total amount expended to June 30, 1891, has been $21,245.69, with great advantage.

A little work was done in October, 1890, in the removal of snags, stumps and logs, and large rocks from the channel, and cutting leaning trees from the banks.

This was resumed in May, 1891, and is now in progress. The work was between the foot of Queen Shoal and Jarretts Ford, which are, respectively, 25 and 12 miles from the mouth of the river.

The law of September 19, 1890, called for an examination of the river with a view to improving the same by locks and dams. A report on the subject was submitted by the local engineer December 13, 1890, which may be found in Appendix I I 6.

July 1, 1890, balance unexpended	$574.89
Amount appropriated by act approved September 19, 1890	2,500.00
	3,074.89
June 30, 1891, amount expended during fiscal year	320.58
July 1, 1891, balance unexpended	2,754.31
July 1, 1891, outstanding liabilities	1,000.00
July 1, 1891 balance available	1,754.31
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	2,500.00

(See Appendix I I 3.)

4. *Gauley River, West Virginia.*—Operations for the improvement of the Gauley River were instituted by an examination made in 1887 in accordance with the provisions of the river and harbor act of August 5, 1886. It was then pointed out that a valuable improvement of the 12 miles of river from the mouth to the "Roughs" could be made at an expense of $10,000, and that a great advantage would follow the expenditure of $65,000 in the 26-mile reach called the "Roughs," in facilitating and cheapening the bringing to market of millions of feet of lumber of the most valuable and varied kinds.

The river and harbor act of August 11, 1888, appropriated $3,000. The project approved for the expenditure of this small sum contemplated the removal of ledges of solid rock and the making of channels through 18 shoals of loose rock and bowlders, commencing at Scramble Creek, about three-fourths of a mile above the mouth, and extending to the pool above Rich Creek, a distance of 10 miles. The work was carried on by the hire of labor and the purchase of materials in open market, the circumstances not permitting contract work from considerations of economy and advantage; it was brought to a close about the middle of October, 1888, by high water, and could not be resumed in the year ending June 30, 1890.

A little work was done in July and August, 1890, but was suspended the end of August for want of funds. A new appropriation of $3,000 was made September 19, 1890, but it was then too late to resume operations in 1890.

Continued high water has prevented work in 1891 up to June 30, except a very little in June.

July 1, 1890, balance unexpended	$1,684.58
Amount appropriated by act approved September 19, 1890	3,000.00
	4,684.58
June 30, 1891, amount expended during fiscal year	1,745.62
July 1, 1891, balance unexpended	2,938.96
July 1, 1891, outstanding liabilities	600.00
July 1, 1891, balance available	2,338.96
Amount (estimated) required for completion of existing project	4,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	4,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix I I 4.)

5. *New River, from the mouth of Wilson, in Grayson County, Virginia, to the mouth of Greenbrier River, West Virginia.*—The appropriations have been made in such manner as to divide this portion of the river into three sections as follows:

	Miles.
Upper, or Lead Mines	62
Middle, or New River Bridge	43
Lower, or Greenbrier	86½

Throughout this distance the navigable channel consisted of natural chutes through the ledges and shoals of varying widths, rarely over 1 foot in depth, in some places so tortuous as to render navigation extremely dangerous and difficult.

The original project adopted for the improvement of these natural channels was to widen them to 30 or 50 feet, as might be required, deepen them to 2 feet, and straighten such as needed it. This was for bateau navigation; the improvement, however, to be made in such a manner as to aid the work should a greater depth and width be required in the future.

A small steamboat, draft 12 inches when light, having been built at Hinton in the fall of 1878, rendered it necessary to make the channel in that section 50 feet wide at all points, and in many from 75 feet to 100 feet, the depth of 2 feet being retained. This steamboat was not adapted in dimensions and power to the navigation of the river and was withdrawn.

The original plan of improvement has been adhered to, except that the width of channel on the middle and upper divisions has been reduced to 20 feet, and on the former to 10 feet for several miles, to allow iron to be shipped from the furnaces above.

There was no appropriation for this river in 1883, 1884, or 1885. July 1, 1886, there was a balance remaining unexpended of $3,000 from the appropriation of August 2, 1882. This pertained by special designation of the law to the portion of the river above Foster Falls, which are not passable. The balance remained unexpended because of the impassability of these falls. As the disconnection with routes of transportation caused by these falls would practically disappear on the completion of the railroad up Cripple Creek, and as boats could then ship to the railroad their freight at Porter Ferry, above the lead mines and falls, it was concluded to improve the condition of Williamson Ledges and Shoals. This work was continued as late as the season allowed, a small balance of funds being left unexpended, but not large enough to justify the resumption of operations in the summer of 1886.

There was an appropriation of $10,000 in the law of August 5, 1886, applicable only to the portion of the river above the Lead mines. When the money became available it was too late to commence operations in

1886. For more than one reason it seemed inexpedient to expend this appropriation in the year ending June 30, 1888. The portion of the river to which it is applicable is above Foster Falls, and these can only be passed by one or two locks. There was also strong reasons for doubt whether, considering the present development of that section of the country, the construction of such locks would be justifiable, even if the money were available. The construction of railroads near this stream had diminished very much the importance of the improvement of the portion above Foster Falls. After a careful reëxamination of the subject and a reconnaissance of the river and its vicinity, it was decided to postpone the expenditure of the appropriation until the will of Congress could be further ascertained.

In the river and harbor act of August 11, 1888, it was, however, directed that the balance should be spent in improving the river between Ivanhoe Furnace, in Wythe County, and the mouth of Wilson Creek. Operations in accordance with this direction were therefore commenced June 9, 1889, and continued until October 10, 1889.

In 1885 there was a channel 2 feet deep and 20 feet wide from Ivanhoe Furnace to within 600 feet of the head of Wilkinson Shoals and Ledges, a distance of 3.9 miles.

In 1889 this channel, with the same width and depth, was extended to the lower end of the approach to the Gulf, a distance of 5 miles from the initial point, with four-tenths of a mile further up the river, partially improved. There were no operations on the river in the year ending June 30, 1891, and therefore no expenditures in that fiscal year. The balance of $2,341.79 remains from the last appropriation, which was in August, 1886.

In compliance with a recommendation of the local engineer, it was decided by the Secretary of War not to expend the existing balance at present.

Up to June 30, 1891, the amount expended was $109,733.21.

July 1, 1890, balance unexpended	$2,341.79
July 1, 1891, balance unexpended	2,341.79
Amount (estimated) required for completion of existing project	159,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix I I 5.)

EXAMINATION FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Elk River, West Virginia, with a view of improving the same by locks and dams*, was made by the local engineer in charge, Colonel Craighill, and report thereon submitted. It is the opinion of Colonel Craighill, based upon the facts and reasons given, that this improvement is not worthy of being undertaken by the United States. This opinion being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc No. 103, Fifty-first Congress, second session. (See also Appendix I I 6.)

IMPROVEMENT OF CERTAIN RIVERS IN KENTUCKY AND WEST VIRGINIA.

Officer in charge, Maj. D. W. Lockwood, Corps of Engineers, with Lieut. W. L. Sibert, Corps of Engineers, under his immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Tradewater River, Kentucky.*—This river was practically closed before the work of improvement commenced, by a rock bar near its mouth, and higher up by logs, snags, drift piles, leaning trees, and bars.

The present project, adopted in 1881, provides for clearing the river and its banks of obstructions, and opening up a channel 40 feet wide and 2½ feet deep during 6 months of the year, the improvement to extend 41 miles upstream from its mouth in the Ohio.

Up to June 30, 1890, $13,643.81 had been expended, resulting in securing a channel through the rock bar near the mouth of the river, and in removing the obstructions in the channel and on the banks of the river for a distance of 41 miles, the distance covered by the present project.

During the fiscal year ending June 30, 1891, $1,837.65 was expended resulting in the removal of the ruins of an old dam at Nunn Ripple, and in clearing the channel and banks of obstructions that had formed since work closed the previous year.

July 1, 1890, balance unexpended	$2,856.19
June 30, 1891, amount expended during fiscal year	1,837.65
July 1, 1891, balance unexpended	1,018.54

(See Appendix J J 1.)

2. *Operating and keeping in repair locks and dams on Green and Barren rivers, Kentucky.*—When the United States acquired possession of these improvements, December 11, 1888, navigation of the system was broken at Lock No. 3, Green River, the river wall of that lock having fallen into the river, the lower end of the land wall of No. 1, Barren, was badly cracked and liable to fall at any time, and both walls of No. 2, Green River, were in a dangerous condition. The channel of the river was much obstructed by snags and slides.

Up to June 30, 1890, $201,138.34 had been expended, resulting in the removal of the old river wall at Lock No. 3; the construction of a coffer-dam inclosing the site of the new wall and in the purchase of stone and cutting of same for it.

At Lock No. 1, Barren River, a coffer-dam was built across the lower end of the lock pit, the broken wall taken down, and the stone purchased for its renewal; a part of the dam was also repaired.

A new snag boat was built, a new dredge hull and a number of barges constructed.

During the fiscal year ending June 30, 1891, $143,113.39 were expended, resulting in the completion of all repairs to lock and dam at Lock No. 1, Barren River, and in the completion of river wall at No. 3, Green River, and the reconstruction of a part of the dam. At Lock No. 1, Green River, the walls were raised to the same level throughout, the banks graded and drained, and guide walls above and below the lock built.

Navigation, which was suspended January 2, 1888, by the falling of the river wall of No. 3, Green River, was reopened November 10, 1890.

A large number of snags, etc., was taken from the river by the snag boat *Wm. Preston Dixon.*

The estimate of the cost of operating and care, etc., for the fiscal year ending June 30, 1892, is $93,980.77.

(See Appendix J J 2.)

3. *Rough River, Kentucky.*—This river is very much obstructed by overhanging trees on the banks and by snags, logs, etc., in the bed of the river. The lower 8 miles of the stream are affected by back water from the Rumsey Dam (No. 2), on Green River, but above this the stream has but little depth at low water.

The project for the improvement adopted in 1890 is to clear the river of obstructions, to wit, overhanging trees on the banks and snags, logs, and stumps in the bed of the river, and to locate and construct a lock and dam near the site of the old ones to carry slack water to Hartford.

The amount of money expended during the fiscal year ending June 30, 1891, was $708.54, and resulted in the survey for the site of lock, dam, and lands; preparing plans for the lock, dam, etc.; in the construction of a quarter boat for working party, and the deadening of trees and removal of obstructions over 2½ miles of the lower river.

Amount appropriated by act approved September 19, 1890	$25,000.00
June 30, 1891, amount expended during fiscal year	708.54
July 1, 1891, balance unexpended	24,291.46
July 1, 1891, outstanding liabilities	552.84
July 1, 1891, balance available	23,738.62
Amount (estimated) required for completion of existing project	80,556.05
Amount that can be profitably expended in fiscal year ending June 30, 1893	80,556.05
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J J 3.)

4. *Kentucky River, Kentucky.*—The condition of the river when the United States assumed charge of its improvements was as follows: The five locks and dams with their approaches, built by the State of Kentucky, were in a dilapidated condition, and the channel was much obstructed by snags and leaning trees.

The project for the improvement, adopted in 1879, called for the necessary repairs to the five locks and dams and the extension of slackwater navigation for a draft of 6 feet, by the construction of additional locks and dams to Beattyville, a distance of 261 miles from the mouth of the river.

Up to the close of the fiscal year ending June 30, 1890, $1,163,077.34 had been expended, resulting in restoring the locks and dams to a navigable condition, clearing the channel and banks of obstructions, and the commencement of two new locks.

Stone had been purchased by contract for Lock No. 6, 30 miles above Frankfort, and a part of the stone for the lock at Beattyville had been gotten out by hired labor. A railroad having been constructed to the junction of the North and Middle forks, and the immediate necessity for a lock at Beattyville thereby done away with, the general project was changed so as to defer the construction of this lock for the present and rearrange the old dam so as to give slack water to Lumber Point, junction of North and Middle forks.

During the fiscal year ending June 30, 1891, $49,378.33 has been expended, resulting in the construction of a cofferdam at No. 6; the construction of the abutment for the dam; excavating inside the coffer for lock; obtaining necessary plant for construction, and in partial completion of the modified project at Beattyville.

July 1, 1890, balance unexpended		$5,276.99
Amount appropriated by act approved September 19, 1890		180,000.00
		185,276.99
June 30, 1891, amount expended during fiscal year		33,460.40
July 1, 1891, balance unexpended		151,816.59
July 1, 1891, outstanding liabilities	$16,267.11	
July 1, 1891, amount covered by uncompleted contracts	9,660.00	
		25,927.11
July 1, 1891, balance available		125,889.48
Amount (estimated) required for completion of existing project		1,674,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix J J 4.)

5. *Operating and keeping in repair locks and dams on Kentucky River, Kentucky.*—The first allotment for this work was for the fiscal year ending June 30, 1885, at which time only four locks could be operated; these required extensive repairs at the time, and the dams and approaches were in a more or less dilapidated condition.

The amount expended to June 30, 1890, was $294,550.76, and resulted in reopening Lock No. 5 to navigation, and placing the other locks and dams in a serviceable condition, the building of guide walls and approaches; the construction of one double and five single lock houses, and in grading, paving, and draining grounds about the locks. A new dredge boat, of the Osgood pattern, and two dump scows were constructed, and general repairs made to locks, dams, etc., and in addition the river was kept clear of snags.

During the fiscal year ending June 30, 1891, $44,215.13 were expended, and resulted in the continuation of grading and paving about lock walls, the construction of a new stone abutment at Lock No. 2, the partial construction of two new lock houses, dredging approaches to locks, snagging, and general repairs to locks and dams.

The estimate of the cost of operating and care, for the fiscal year ending June 30, 1891, is $40,770.

(See Appendix J J 5.)

6. *Licking River, Kentucky, from Farmer to West Liberty.*—This stream was originally much obstructed by logs, snags, rocks, and leaning trees, as well as by fish dams constructed by private parties.

The project for the improvement was adopted in 1888 and provides for removing the rocks, snags, and bowlders from the river bed.

The amount expended to June 30, 1890, was $2,867.95, and resulted in the removal from the bed of the river of a large number of rocks, snags, etc., that obstructed both rafting and low-water navigation.

The amount expended during the fiscal year ending June 30, 1891, was $1,600.91, and resulted in the further improvement of rafting and low-water navigation by removal of obstructions from the bed and banks of the river.

July 1, 1890, balance unexpended	$132.08
Amount appropriated by act approved September 19, 1890	3,000.00
	3,132.08
June 30, 1891, amount expended during fiscal year	1,097.41
July 1, 1891, balance unexpended	2,034.67
July 1, 1891, outstanding liabilities	503.50
July 1, 1891, balance available	1,531.17

Amount (estimated) required for completion of existing project	$11,680.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J J 6.)

7. *Big Sandy River, West Virginia and Kentucky.*—When the United States commenced improving this stream it and its forks were much obstructed by rocks, bars, snags, and leaning trees. During the low-water season navigation was practically suspended.

The present project was adopted in 1878, and provided for improving the push-boat and rafting facilities of the river and forks by removing obstructions, etc. This was modified in 1880, to secure slack-water navigation by the construction of a test lock and dam near Louisa, Ky.

The amount expended to June 30, 1890, was $213,827.36, and resulted in improving low-water navigation by the removal of rocks, snags, stumps, and logs from the channel and leaning trees from the banks of the river, and in the construction of a lock complete, near Louisa, together with the abutment for a dam.

The amount expended during the fiscal year ending June 30, 1891, was $18,711.64, and resulted in deepening the approaches to the lock by blasting out the rock; constructing a part of the dam and purchasing a part of the timber for completion of same; also in filling in behind abutment, grading, etc.

July 1, 1890, balance unexpended		$15,202.64
Amount appropriated by act approved September 19, 1890		31,000.00
		46,202.64
June 30, 1891, amount expended during fiscal year		16,468.49
July 1, 1891, balance unexpended		29,734.15
July 1, 1891, outstanding liabilities	$2,273.15	
July 1, 1891, amount covered by uncompleted contracts	6,946.06	
		9,219.21
July 1, 1891, balance available		20,514.94

(See Appendix J J 7.)

8. *Levisa Fork, Big Sandy River, Kentucky.*—This stream was originally much obstructed by rocks, snags, logs, and overhanging trees. Its improvement has been in progress since work on the Big Sandy was commenced under the project for the improvement of that stream.

The present project was adopted in 1890 and provides for the removal of snags, logs, stumps, rocks, etc., from the river and overhanging trees on the banks.

The amount expended to June 30, 1890, was $18,250, and resulted in the material improvement of navigation; push boats at low water and rafting and light-draft steamboat navigation at moderate stages.

The amount expended during the fiscal year ending June 30, 1891, was $1,348.24, and resulted in the removal of snags, rocks, logs, and stumps from the river bed.

Amount appointed by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	1,348.24
July 1, 1891, balance unexpended	1,151.76
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix J J 8.)

9. *Tug Fork, Big Sandy River, West Virginia and Kentucky.*—This stream was originally much obstructed by rocks, snags, logs, and overhanging trees. Its improvement has been in progress since work on the Big Sandy was commenced under the project for the improvement of that stream.

The present project was adopted in 1890 and provides for the removal of snags, logs, stumps, rocks, etc., from the river and overhanging trees on the banks.

The amount expended to June 30, 1890, was $18,250, and resulted in the material improvement of navigation; push boats at low water and rafting and light-draft steamboat navigation at moderate stages.

The amount expended during the fiscal year ending June 30, 1891, was $1,078.33, and resulted in the removal of snags, rocks, logs, and stumps from the river bed.

Amount appropriated by act approved September 19, 1890	$2,500.00
June 30, 1891, amount expended during fiscal year	1,078.33
July 1, 1891, balance unexpended	1,421.67
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	2,500.00

(See Appendix J J 9.)

10. *Guyandotte River, West Virginia.*—This stream was originally much obstructed by snags, logs, leaning trees, the remains of old dams, and milldams owned by private parties which required removal.

The project for the improvement was adopted in 1878, and provided for the removal of existing obstructions, natural and artificial, so as to form a channel 30 feet wide, with a least depth of 18 inches, during 5 months of the year, and extending up the river a distance of 122 miles from the Ohio.

Up to the close of the fiscal year ending June 30, 1890, $14,373.45 had been expended, resulting in the partial improvement of the river for a distance of 119 miles, removing snags, logs, etc., from the channel and cutting passage ways through old dams.

During the fiscal year ending June 30, 1891, $1,145.25 was expended, resulting in the removal of snags, etc., and in cutting through bars and ripples above Logan Court House to improve rafting navigation.

July 1, 1890, balance unexpended	$126.55
Amount appropriated by act approved September 19, 1890	2,000.00
	2,126.55
June 30, 1891, amount expended during fiscal year	729.55
July 1, 1891, balance unexpended	1,397.00
July 1, 1891, outstanding liabilities	415.70
July 1, 1891, balance available	981.30
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	5,000.00

(See Appendix J J 10.)

11. *Little Kanawha River, West Virginia.*—This river, at the time improvements were commenced by the United States, was much obstructed by logs, snags, leaning trees, etc., above that portion controlled by the Little Kanawha Navigation Company.

The original project, adopted in 1876, was for the removal of Beaver

and Nailor Bend rocks, and for cleaning out snags and fallen trees. This was modified in 1880 by the adoption of an additional project for the construction of a lock and dam 2 miles above Burning Springs, W. Va.

Up to June 30, 1890, $170,175.96 had been expended, resulting in placing the upper part of the river in a fair rafting condition, and so that during moderate stages light-draft steamboats could run as far as Grantsville. The masonry of the lock was completed and a lock house built.

During the past fiscal year $15,245.01 were expended, and resulted in the construction of the abutment for the dam, the construction of 65 feet of the dam, and in filling in and grading behind lock wall.

July 1, 1890, balance unexpended		$1,029.04
Amount appropriated by act approved September 19, 1890		40,000.00
		41,029.04
June 30, 1891, amount expended during fiscal year		13,713.75
July 1, 1891, balance unexpended		27,315.29
July 1, 1891, outstanding liabilities	$1,561.26	
July 1, 1891, amount covered by uncompleted contracts	3,848.03	
		5,409.29
July 1, 1891, balance available		21,906.00

(See Appendix J J 11.)

12. *Buckhannon River, West Virginia.*—This stream was originally so obstructed by rocks and log jams that timber could be floated out only on a 12-foot rise.

The project for its improvement, adopted in 1884, provides for the formation of a rafting channel 24½ miles long, with a minimum width of 30 feet.

The amount expended to June 30, 1890, was $4,445.60, and resulted in clearing out some of the worst rocks and log jams.

The amount expended during the fiscal year ending June 30, 1891, was $17 for individual expenses, no field work having been done.

July 1, 1890, balance unexpended	$44.40
Amount appropriated by act approved September 19, 1890	1,000.00
	1,044.40
June 30, 1891, amount expended during fiscal year	17.00
July 1, 1891, balance unexpended	1,027.40

(See Appendix J J 12.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Lockwood, and reports thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Lockwood, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress, and printed as executive documents of the Fifty-first Congress, second session.

1. *Big Barren River, Kentucky, above Bowling Green with a view of extending slack-water navigation by additional locks and dams.*—Printed as House Ex. Doc. No. 15. (See also Appendix J J 13.)

2. *Russel's Fork of the Big Sandy River, Kentucky, with the view of removing obstructions from the same.*—Printed as House Ex. Doc. No. 29. (See also Appendix J J 14.)

The required preliminary examination of *Green River, Kentucky, above the mouth of Big Barren River, with a view of extending slack water navigation on Green River*, was made by the local engineer in charge, Major Lockwood, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Lockwood, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. The proposed improvement contemplates the construction of two locks and dams, so as to extend slack-water navigation to Mammoth Cave, at an estimated cost of $361,346.40. (See Appendix J J 15.)

LAKE HARBORS AND RIVERS.

IMPROVEMENT OF HARBORS ON LAKE SUPERIOR.

Officers in charge, Maj. James B. Quinn, Corps of Engineers, to December 31, 1890, with Lieut. Graham D. Fitch, Corps of Engineers, under his immediate orders; Lieut. Graham D. Fitch, Corps of Engineers, from that date to February 28, 1891; and Capt. W. L. Fisk, Corps of Engineers, since February 28, 1891; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Harbor at Grand Marais, Minnesota.*—This small natural basin was not of sufficient depth or adequately sheltered for the purpose of general commerce, and as it was essential to have a harbor of refuge at this locality, it was proposed to provide the requisite shelter by building a pier out from Mayhew Point and to secure the necessary depth of water by dredging.

A little dredging was done in 1879, and work on the pier commenced in 1880.

The available anchorage area having full 16 feet depth is at present 15.1 acres and will be about 22 acres at close of present contract. The quantity of material dredged during the year was 29,929.1 cubic yards. The pier is 350 feet long and in fairly good condition.

The total expenditure to June 30, 1890, was $93,675.49.

The amount expended during the fiscal year was $785.66.

July 1, 1890, balance unexpended		$1,324.51
Amount appropriated by act approved September 19, 1890		22,350.00
		23.674.51
June 30, 1891, amount expended during fiscal year		785.66
July 1, 1891, balance unexpended		22,888.85
July 1, 1891, outstanding liabilities	$5,985.82	
July 1, 1891, amount covered by uncompleted contracts	14,170.18	
		20,156.00
July 1, 1891, balance available		2,732.85

Amount (estimated) required for completion of existing project.....	$22,319.40
Amount that can be profitably expended in fiscal year ending June 30,1893	22,350.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 1.)

2. *Harbor at Agate Bay, Minnesota.*—This is a shipping port for iron ore, and when the breakwater piers are built will form a harbor of refuge. It is 27 miles east of Duluth.

The project for the improvement of this harbor was adopted in 1887, and contemplates the erection of two piers projecting from the headlands of the bay and inclosing about 109 acres of water area. The eastern pier is to be 1,000 feet long and the western one 900 feet. Work upon the east pier was commenced in 1887 and at the date of the last annual report 550 feet of it had been built. The contract now in progress will complete 200 feet more.

The beneficial effects of the work done are greater than were anticipated, the tranquillity of the harbor has been greatly augmented, and vessels are no longer obliged to put to sea during storms, but can find saftety under the shelter of the breakwater.

Amount expended to June 30, 1890, $35,519.79; amount expended during fiscal year ending June 30, 1891, $736.

July 1, 1890, balance unexpended	$1,980.21
Amount appropriated by act approved September 19, 1890	25,000.00
	26,980.21
June 30, 1891, amount expended during fiscal year	736.00
July 1, 1891, balance unexpended	26,244.21
July 1, 1891, amount covered by uncompleted contracts	23,400.00
July 1, 1891, balance available	2,844.21

Amount (estimated) required for completion of existing project.....	181,708.00
Amount that can be profitably expended in fiscal year ending June 30,1893	135,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 2.)

3. *Harbor at Duluth, Minnesota.*—The original project for the improvement of the harbor, adopted in 1871, consisted of a breakwater in Lake Superior, outside of Minnesota Point, in continuation of one already commenced by the Northern Pacific Railroad Company. This breakwater was destroyed by a storm in 1872 and abandoned. In 1873 Congress provided for maintaining the canal through Minnesota Point, which had been constructed by the city of Duluth, and for dredging channels in Superior Bay to the Duluth docks.

Work under this project was continued until 1881, at which time the piers of the canal had been repaired and somewhat extended, a harbor basin dredged of moderate capacity, and a narrow channel dredged in Superior Bay from Duluth to deep water at Connor Point. The amount expended under this project was $270,651.81.

The present project was adopted in 1881 and modified in 1884 and 1888, the object being to preserve the piers bordering the canal, dredging an inner harbor to accommodate vessels drawing 16 feet of water, channel parallel with the Park Point dock line 100 feet wide, channel east of Rice Point 200 feet wide and 17 feet deep, and channel on north shore of St. Louis Bay 200 feet wide, 17 feet deep.

The amount expended under present project to June 30, 1890, was $538,533.70, and has resulted in increasing the dredged area of harbor

basin to about 104 acres, exclusive of private dredging, removing shoals from area previously dredged, giving the whole dredged basin a minimum depth of 16 feet, deepening the Blast Furnace Channel to a like depth, maintaining the canal piers, and commencement of channels east of Rice Point and on north shore of St. Louis Bay. The Blast Furnace Channel was abandoned upon the establishment of the new dock lines.

Work during the past year consisted in enlarging the new channel east of Rice Point to a width of 110 feet throughout its length of 8,460 feet and beginning the enlargement of the channel on the north side of St. Louis Bay. This season's work is expected to give the latter channel a width of about 100 feet. The amount of material dredged from the former channel was 234,366.4 and from the latter 90,530.9 cubic yards.

The canal piers are in a poor condition, and the entire work needs to be replaced with an improved and permanent structure.

The harbor basin and connecting channels will eventually require deepening to 22 feet. The channels recently commenced should be completed at an early date, both for the accommodation of commerce and as a matter of economy. The ruling depths in the portions of the harbor dredged by the United States are—

	Feet.
In canal	17
In the inner basin, or harbor	16
In channel on north shore of St. Louis Bay for a distance of about 12,900 feet	14
In new channel east of Rice Point.	16

July 1, 1890, balance unexpended		$14,015.92
Amount appropriated by act approved September 19, 1890		100,000.00
		114,015.92
June 30, 1891, amount expended during fiscal year		51,182.19
July 1, 1891, balance unexpended		62,833.73
July 1, 1801, outstanding liabilities	1,267.51	
July 1, 1891, amount covered by uncompleted contracts	41,324.83	
		42,592.34
July 1, 1891, balance available		20,241.39

Amount (estimated) required for completion of existing project	224,526.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	224,526.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix K K 3.)

4. *Harbor at Superior Bay and St. Louis Bay, Wisconsin.*—Originally the natural entry to Superior Bay was obstructed with shifting bars having at most but 9 feet depth of water over them. The citizens of Superior attempted to remedy this by constructing piers to confine the outflowing waters of the bay, and this work was taken up by the United States in 1867, and has successfully maintained since then a ruling depth of 16 feet between the piers.

The piers are 350 feet apart, and a good deal of dredging has been necessary to obtain the required depth between them and the channels leading to Connor Point and the Quebec Dock and a new connecting channel in St. Louis Bay. The original project of 1867 has, therefore, been modified from time to time to meet the needs of the rapidly increasing capacity of the vessels visiting this port, the last modification being made by act of Congress approved August 5, 1886, which added improvement of channel in St. Louis Bay.

In carrying out the original project with modifications there has been expended to June 30, 1890, the sum of $495,046.59.

Operations during the past year have consisted in dredging a channel through the bar at the mouth of Nemadji River, beginning the widening and continuing the extension of channel in St. Louis Bay.

The entry piers need extensive repairs, particularly the superstructure. The entry and dredged channels have full 16 feet depth.

July 1, 1890, balance unexpended		$16,050.54
Amount appropriated by act approved September 19, 1890		65,000.00
		81,050.54
June 30, 1891, amount expended during fiscal year		9,375.89
July 1, 1891, balance unexpended		71,674.65
July 1, 1891, outstanding liabilities	$13,759.54	
July 1, 1891, amount covered by uncompleted contracts	32,256.54	
		46,016.08
July 1, 1891, balance available		25,658.57
Amount (estimated) required for completion of existing project		226,736.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		175,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix K K 4.)

5. *Minnesota Point at Superior, Wisconsin.*—The object of this work is to protect the channel from the old entrance to Superior Bay from drifting sand and to prevent the Lake from cutting through Minnesota Point into the bay at a low place known as "The Opening."

The project approved October 23, 1890, is for a double post and board fence of a total length of 1,216 feet filled in with brush and stone to catch the sand.

The fence was completed May 27, 1891, and is accomplishing the purpose for which it was built.

Amount appropriated by act approved September 19, 1890	$4,895.00
June 30, 1891, amount expended during fiscal year	4,526.59
July 1, 1891, balance unexpended	368.41

(See Appendix K K 5.)

6. *Harbor at Ashland, Wisconsin.*—Ashland Harbor is located at the head of Chequamegon Bay, and originally had no protection from the waves which rolled into the bay or from the waves generated within the bay itself by storms.

The approved project is for the construction of a pile, slab, and rock breakwater 8,000 feet long northeast of the town, and for dredging a channel in front of the wharves of the city to accommodate vessels drawing 16 feet of water. During the season of 1889 a portion of the breakwater 4,650 feet in length was completed, but a severe storm in November the same year destroyed the outer 50 feet and the slab filling settled in some places. At the date of the last annual report repairs were under way and were completed early in the season. The contract now in progress will extend the breakwater 1,080 feet and close the breach in Chequamegon Point with a brush and stone dike. No dredging has yet been done.

The amount expended during the year was $17,451.24.

The total amount expended under approved project to June 30, 1890, was $66,398.73.

The breakwater, though of insufficient length to give full protection

to all the wharves of the city, has nevertheless had a marked influence in improving the tranquillity of the harbor.

July 1, 1890, balance unexpended		$22,213.44
Amount appropriated by act approved September 19, 1890		60,000.00
		82,213.44
June 30, 1891, amount expended during fiscal year		17,451.24
July 1, 1891, balance unexpended		64,762.20
July 1, 1891, amount covered by uncompleted contracts		54,276.00
July 1, 1891, balance available		10,486.20
Amount (estimated) required for completion of existing project		187,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867		

(See Appendix K K 6.)

7. *Harbor at Ontonagon, Michigan.*—The entrance to Ontonagon River, which forms the harbor, had but 7 feet depth in 1867, at which time the project for securing 12 feet depth by building parallel piers on either side of the mouth, extending to the 18-foot curve of depth in Lake Superior, and dredging a channel between the piers, was adopted.

The west pier has reached a length of 2,675 feet, and is very nearly out to the 18-foot curve of depth, as proposed. But this curve has advanced in the meantime, owing to the very considerable volume of sand carried into the lake by the river, and since it appears probable that the advance of the bar will keep pace with the extension of the piers, unless a very considerable extension is made at once, a consideration scarcely to be expected, it does not appear that economic considerations would justify any further extension of the piers at present. The east pier is 2,315 feet in length.

For a time it seems that better results will be secured, after the piers are put in repair and the superstructures to outer cribs of west pier are finished, by dredging across the bar after each spring freshet.

The channel between the piers has kept a depth of over 12 feet and a dredged channel through the bar has just been completed. The superstructure on the remaining 150 feet of the west pier is in progress and will be completed this season.

The amount expended during the fiscal year just closed was $952.17.

The total cost of the improvement to June 30, 1890, is $296,157.80.

July 1, 1890, balance unexpended		$1,942.11
Amount appropriated by act approved September 19, 1890		10,000.00
		11,942.11
June 30, 1891, amount expended during fiscal year		952.17
July 1, 1891, balance unexpended		10,989.94
July 1, 1891, outstanding liabilities	$5,673.07	
July 1, 1891, amount covered by uncompleted contracts	3,255.00	
		8,928.07
July 1, 1891, balance available		2,061.87
Amount (estimated) required for completion of existing project		55,670.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		55,670.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix K K 7.)

8. *Eagle Harbor, Michigan.*—Previous to the improvement of Eagle Harbor the entrance was obstructed by a rocky reef, with 8½ feet of water over the shoalest part.

The project for the improvement of this harbor was adopted in 1866 and modified in 1868, 1874, and 1878. The plan, as finally carried out, consisted in blasting and dredging through the rocky ledge a channel 130 feet wide and 14 feet deep, and marking it with two guiding cribs, one on each side of the channel, and the removal of a number of bowlders.

The amount expended to the close of the fiscal year ending June 30, 1891, was $94,513.67, and has resulted in carrying out the above project, the work having been completed in 1879, and meeting the present demands of commerce.

No appropriation is asked for this harbor, as the funds available will probably be sufficient to keep the work in good order for several years longer.

July 1, 1890, balance unexpended	$2,486.33
July 1, 1891, balance unexpended	2,486.33

(See Appendix K K 8.)

9. *Harbor at Marquette, Michigan.*—Originally this harbor afforded no protection to vessels from the easterly or northeasterly storms, and in 1866 a project was approved for the construction of a breakwater composed of cribs filled with rock, and projecting from the shore into the bay a distance of 2,000 feet. This pier was finished practically as projected in 1875, but since its commencement extensive repairs have been made to the superstructure.

As the timber composing the superstructure has been in place far longer than supposed probable, it is essential that it be replaced by more durable material. A project for a concrete superstructure was approved in February, 1890. Its estimated cost is $232,936.71.

In the river and harbor act of August 11, 1888, provision was made for the extension of the breakwater. In 1889 work upon the first 180 feet of this extension was commenced, but owing to the violence of storms towards the end of the season, before the work was finished, a greater portion of the crib substructure was ruined. There was finished but 60 feet of crib work and 180 feet of riprap foundation. The contract now in progress will extend the breakwater 240 feet.

The amount expended during the fiscal year ending June 30, 1891, was $2,340.96.

The total cost of the work to June 30, 1890, was $347,579.62.

July 1, 1890, balance unexpended		$6,800.38
Amount appropriated by act approved September 19, 1890		40,000.00
		46,800.38
June 30, 1891, amount expended during fiscal year		2,340.96
July 1, 1891, balance unexpended		44,459.42
July 1, 1891, outstanding liabilities	$100.00	
July 1, 1891, amount covered by uncompleted contracts	28,080.00	
		28,180.00
July 1, 1891, balance available		16,279.42
Amount (estimated) required for completion of existing project		355,736.71
Amount that can be profitably expended in fiscal year ending June 30, 1893		222,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix K K 9.)

10. *Harbor of refuge at Grand Marais, Michigan.*—Originally the entrance to this harbor was obstructed by a bar, having but about 6 feet depth of water upon it. The project for its improvement, adopted in 1881, has for its object a deep and safe channel into the harbor, making it a harbor of refuge. This object is to be attained by building parallel piers projecting into the lake, and dredging out a channel between them, connecting the deep water of the lake with that of the harbor.

The proposed length of each pier was 1,800 feet. The west pier has now reached a length 1,406 feet, and the east pier 853 feet.

A channel 150 feet wide and 17 feet deep was dredged out between the piers. This deep channel has shoaled until it has but from 7 to 9 feet depth.

The contracts now in force are for repairing the piers, building new shore end to the east pier, and dredging about 146,000 cubic yards, to be begun by July 1.

The amount expended during year ending June 30, 1891, was $1,388.77.

The total amount expended under approved project to June 30, 1890, was $179,571.78.

July 1, 1890, balance unexpended		$1,726.92
Amount appropriated by act approved September 19, 1890		50,000.00
		51,726.92
June 30, 1891, amount expended during fiscal year		1,385.77
July 1, 1891, balance unexpended		50,341.15
July 1, 1891, outstanding liabilities	$19.20	
July 1, 1891, amount covered by uncompleted contracts	43,151.00	
		43,170.20
July 1, 1891, balance available		7,170.95
Amount (estimated) required for completion of existing project		218,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix K K 10.)

11. *Resurvey and relocation of harbor line in Portage Lake, Houghton County, Michigan.*—Under the provisions of act of June 20, 1890, a Board of Engineers was constituted to report upon the subject of new harbor lines in Portage Lake, Michigan. A survey for the use of the Board was made in October, November, and December, 1890.

The report of the Board was approved by the Secretary of War January 5, 1891 (see Appendix K K 13), and the local engineer in charge was directed to carry out certain recommendations therein for the placing of permanent marks and the preparation of a description of the harbor lines. Twenty stone monuments were set as reference points for the lines, but the description of the harbor lines has not been completed.

(See Appendix K K 14.)

EXAMINATIONS AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Allonez* [*Allouez*] *Bay at the west end of Lake Superior, also the Nemadji River for a distance of* 4 *miles above its mouth, with a view of determining the best method of improving and making them available as a portion of the harbor system of the city of Superior, Wisconsin*, was made by the local engineer in charge, Major Quinn, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the

opinion of Major Quinn, based upon the facts and reasons given, that these localities are worthy of improvement; but Colonel Poe considers that Nemadji River is not, at the present time, worthy of improvement to the extent proposed. The views of Colonel Poe being concurred in by me, no further survey was ordered. The report was transmitted to Congress and printed as House Ex. Doc. No. 40, Fifty-first Congress, second session. (See also Appendix K K 11.)

The required preliminary examination of *the St. Louis River, Minnesota, from Grassy Point in St. Louis Bay to Fond du Lac, or the State line between Minnesota and Wisconsin*, was made by the local engineer in charge, Major Quinn, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Quinn, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Major Quinn was charged with its survey, the report on which will be submitted when received.

Major Quinn was charged with *resurvey and relocation of harbor line in Portage Lake, Houghton County, Michigan*, provided for in section 17 of river and harbor act approved September 19, 1890. The report of Board of Engineers constituted under provisions of act approved June 20, 1890, upon harbor lines in Portage Lake, Michigan, was submitted under date of December 11, 1890, and approved by the Secretary of War January 5, 1891. The report was transmitted to Congress and printed as House Ex. Doc. No. 200, Fifty-first Congress, second session, and is submitted herewith as Appendix K K 13. The annual report of Captain Fisk upon this subject is submitted as Appendix K K 14.

IMPROVEMENT OF HARBORS ON WESTERN SHORE OF LAKE MICHIGAN, NORTH OF CHICAGO, ILLINOIS, AND OF FOX AND WISCONSIN, AND MENOMONEE RIVERS, WISCONSIN.

Officer in charge, Maj. Charles E. L. B. Davis, Corps of Engineers, with Lieut. H. E. Waterman, Corps of Engineers, under his immediate orders; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Manistique Harbor, Michigan.*—The natural channel of entrance to the mouth of the Manistique River was 7 feet deep. By private enterprise 3,000 feet of slab piers had been built at the mouth of the river, and a channel dredged to 10 feet before any appropriation had been made by the Government.

The project for the improvement of the harbor was adopted in 1880, and consisted in dredging between the piers built by the Chicago Lumbering Company, increasing the depth of the channel to 12 feet for a width of 150 feet.

By the acts of 1880 and 1881 the sum of $6,000 was appropriated for this harbor in order to dredge a channel between the private piers of the above-mentioned dimensions. Dredging was done to the amount of 11,780 cubic yards at a cost of $2,989.21, and work was then suspended in consequence of the refusal of the company controlling the harbor to rectify their pier lines when rebuilding the same.

Nothing has been done since work was suspended in 1881.

Soundings taken in May, 1890, showed an available but tortuous channel 13 feet deep and 60 feet wide.

July 1, 1890, balance unexpended	$2,845.76
June 30, 1891, amount expended during fiscal year	245.00
July 1, 1891, balance unexpended	2,600.76

(See Appendix K K L 1.)

2. *Cedar River Harbor, Michigan.*—Previous to improvement the mouth of Cedar River was 175 feet wide and 8 to 10 feet deep, with a 3-foot bar in front.

Improvements had been made by private parties prior to the commencement of Government work.

The project of improvement was adopted in 1883, with a modification in the direction of the piers in 1884, the object being to afford an entrance channel of navigable width and 14 feet in depth.

Up to June 30, 1890, there had been expended $27,711.93, resulting in the construction of two pile piers 754 and 301 feet long, respectively, in continuation of the slab docks built by private enterprise, and a channel that in October, 1885, was 50 feet wide and 13 feet deep, and 100 feet wide for a depth of 11 feet.

During the fiscal year ending June 30, 1891, $70 has been expended in contingent expenses, but no work of improvement has been carried on since the close of the season of 1885.

Soundings taken in May, 1890, showed a channel of 11, 12, and 13 feet, with corresponding widths of 60, 40, and 20 feet, doubtless due to dredging by private parties.

July 1, 1890, balance unexpended	$2,288.07
June 30, 1891, amount expended during fiscal year	70.00
July 1, 1891, balance unexpended	2,218.07
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	108,000.00

(See Appendix L L 2.)

3. *Menomonee Harbor, Michigan and Wisconsin.*—Previous to the improvement of this harbor the depth of water at the mouth of the Menonomee River was about 4 feet, and the river was navigable for boats of that draft for some 2 miles above its mouth.

The project for the improvement of the harbor was adopted in 1871 and modified in 1874, the object being to afford a channel of entrance of navigable width and not less than 14 feet depth.

The amount expended up to June 30, 1890, was $206,923.87, resulting in the construction of two piers, 400 feet apart, the north pier 1,854 feet long and the south pier 2,710 feet long, with a dredged channel between, 14 feet deep and 270 feet wide, this channel extending across a bar about 350 feet beyond the south pier.

During the fiscal year ending June 30, 1891, $1,852.67 was expended in the removal of 14,170 cubic yards of material from the channel, restoring it to a width of from 200 to 300 feet and a depth of 14 feet.

July 1, 1890, balance unexpended	$5,083.23
June 30, 1891, amount expended during fiscal year	1,852.67
July 1, 1891, balance unexpended	3,230.56

(See Appendix L L 3.)

4. *Menomonee River, Michigan and Wisconsin.*—At present there is a narrow and intricate channel of 13 feet from the inner ends of the harbor piers to N. Ludington & Co.'s mill.

Section 13 of the river and harbor act of August 11, 1888, called for a survey of the Menomonee River from the waters of Green Bay to N. Ludington & Co.'s mill, Wisconsin, for a channel 16 feet deep and 200 feet wide.

A report of this survey, map, and estimate of cost of the proposed

deepening channel were submitted November 26, 1889, and published in House Ex. Doc. No. 34, Fifty-first Congress, first session. The estimated cost was $109,609.80. The river and harbor act of September 19, 1890, appropriated $54,000 for "continuing the improvement up the river from termination of old work," and the present approved project is for dredging a channel 200 feet wide and 16 feet deep from Green Bay up the Menomonee River as far as the funds available will allow.

A contract for dredging 200,000 cubic yards, more or less, was entered into December 13, 1890. Work was commenced May 11, 1891, and at the close of the fiscal year ending June 30, 1891, 26,058 cubic yards had been dredged.

Amount appropriated by act approved September 19, 1890		$54,000.00
June 30, 1891, amount expended during fiscal year		11,072.32
July 1, 1891, balance unexpended		42,927.68
July 1, 1891, outstanding liabilities	$2,181.00	
July 1, 1891, amount covered by uncompleted contracts	22,566.84	
		24,747.84
July 1, 1891, balance available		18,179.84
Amount (estimated) required for completion of existing project		55,609.80
Amount that can be profitably expended in fiscal year ending June 30, 1893		20,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 4.)

5. *Oconto Harbor, Wisconsin.*—In its natural condition the channel at the entrance to the Oconto River was obstructed by a bar with less than 2 feet of water over it. Previous to 1881, when the first appropriation was made for its improvement, the citizens, by the construction of a small amount of slab pier and by dredging, had increased the depth to 3½ feet.

The project of improvement, adopted in 1882, proposes to secure an 8-foot channel from Green Bay to the city of Oconto, a distance of 2 miles, by dredging and constructing piers, at an estimated cost of $150,000.

The total amount expended up to June 30, 1890, was $64,245.62, resulting in the building of two piers, the north pier 1,603 feet, and the south pier 2,151 feet in length, the latter being the full length contemplated by the approved project, and in the removal of 405,356 cubic yards of material. Owing to the narrowness of the dredged channel and the soft character of the material the spring freshets have a tendency to obliterate the dredging of the previous year.

No work has been done during the fiscal year ending June 30, 1891.

July 1, 1890, balance unexpended		$3,732.88
June 30, 1891, amount expended during fiscal year		767.75
July 1, 1891, balance unexpended		2,965.13
Amount (estimated) required for completion of existing project		82,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 5.)

6. *Pensaukee Harbor, Wisconsin.*—The original depth of water at the mouth of the Pensaukee River was 2 feet, increased by private enterprise to from 7 to 9 feet for a width of 30 feet.

The project for the improvement of this harbor was adopted in 1883

and consisted of the construction of a single slab pier 2,500 feet long, in continuation of the pier built by private enterprise, and dredging a channel 10 feet deep and 100 feet wide on the south side of the pier.

The total amount expended up to June 30, 1890, was $11,197.74, resulting in the construction of 1,300 feet of the proposed extension of the pier and the dredging of 5,698 cubic yards of material, making a channel 25 feet wide and 10 feet deep. No work has been done on this harbor since the season of 1885.

There being at present no commercial or navigation interests to be benefited by improving the harbor, and the harbor itself not being needed as a harbor of refuge, further operations have been suspended.

July 1, 1890, balance unexpended	$3,801.26
June 30, 1891, amount expended during fiscal year	70.00
July 1, 1891, balance unexpended	3,731.26
Amount (estimated) required for completion of existing project	35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 6.)

7. *Green Bay Harbor, Wisconsin.*—Before the improvement of this harbor was begun the channel between the mouth of the Fox River and the deep water in Green Bay was circuitous and narrow, with but 6 feet of water at its shoalest point.

The project of improvement was adopted in 1866, and subsequently modified, so as to provide increased depth, in 1872 and 1874, the object being to provide a dredged channel 200 feet wide, 14 feet deep, and 2 miles long, in place of the natural channel, with a revetted cut across Grassy Island.

There was expended up to the close of the fiscal year ending June 30, 1890, $280,325.23, resulting in a dredged channel 10,600 feet long, 200 feet wide, and 14 feet deep, except where occasional shoals reduced the depth to 13 feet, and in the construction of 1,325 linear feet of pile and timber revetment of the sides of the cut through Grassy Island.

During the fiscal year ending June 30, 1891, $7,030.97 has been expended.

A special agreement was made with the Green Bay Dredge and Pile Driver Company for the removal of 20,000 cubic yards of material from the channel, and the work was completed September 5, 1890.

December 13, 1890, a contract was entered into for the removal of 36,000 cubic yards to restore the channel to its full width and depth, and 29,737 cubic yards had been removed at the close of the fiscal year.

July 1, 1890, balance unexpended		$7,255.77
Amount appropriated by act approved September 19, 1890		10,000.00
		17,255.77
June 30, 1891, amount expended during fiscal year		7,030.97
July 1, 1891, balance unexpended		10,224.80
July 1, 1891, outstanding liabilities	$818.96	
July 1, 1891, amount covered by uncompleted contracts	6,241.68	
		7,060.64
July 1, 1891, balance available		3,164.16
Amount (estimated) required for completion of existing project		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 7.)

8. *Harbor of refuge at entrance of Sturgeon Bay Canal, Wisconsin.*—Before the construction of this harbor was undertaken, the Lake Michigan entrance to the Sturgeon Bay and Lake Michigan Ship Canal was entirely unprotected from storms ranging from northeast to southwest.

The project of constructing a harbor of refuge at this point was adopted in 1873, and modified in 1879 and 1880. The modified project, as carried out, consists of two piers, each 1,344 feet long, 850 feet apart at the shore line, protecting the lake entrance of the canal, and converging so as to make the harbor entrance 335 feet wide, inclosing an area of about 10 acres, with a depth of at least 16 feet.

The total expenditure at this harbor up to June 30, 1890, was $164,903.34, resulting in the entire completion of the piers as projected, and in the dredging of 139,822 cubic yards of material, giving a channel nearly 16 feet deep at the entrance and 14 feet or more thence to the canal, making a depth of 14 feet over the greater part of the sheltered area.

During the fiscal year ending June 30, 1891, $66.31 has been expended in care and maintenance of harbor.

July 1, 1890, balance unexpended	$91.66
Amount appropriated by act approved September 19, 1890	3,000.00
	3,091.66
June 30, 1891, amount expended during fiscal year	66.31
July 1, 1891, balance unexpended	3,025.35
July 1, 1891, outstanding liabilities	70.00
July 1, 1891, balance available	2,955.35
Amount (estimated) required for completion of existing project	12,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 8.)

9. *Ahnapee Harbor, Wisconsin.*—Previous to the improvement of this harbor the depth of water at the mouth of the Ahnapee River was only about 2 feet.

The project of improvement adopted in 1875 and modified in 1884, provided for the formation of a small artificial harbor, connected with the lake by a channel 100 feet wide and 12 feet deep, formed by the construction of two piers extending to the 18-foot contour, with a 200-foot entrance between the pier-heads.

The total amount expended up to June 30, 1890, was $158,772.20, resulting in the construction of two piers, the north one 1,102 feet long, and the south one 1,125 feet, and in the removal of 29,876 cubic yards of rock, and 107,638 cubic yards of sand.

During the fiscal year ending June 30, 1891, $2,436.46 has been expended in building 200 feet of superstructure of the north pier. In November, 1890, there was a channel 60 feet wide and 11¼ feet deep.

July 1, 1890, balance unexpended	$1,163.30
Amount appropriated by act approved September 19, 1890	6,000.00
	$7,163.30
June 30, 1891, amount expended during fiscal year	2,436.46
July 1, 1891, balance unexpended	4,726.84

Amount that can be profitably expended in fiscal year ending June 30, 1893 $19,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 9.)

10. *Kewaunee Harbor, Wisconsin.*—The natural entrance to this harbor was through the Kewaunee River. The river mouth was not more than 20 feet wide, with a depth of about 2 feet at its shoalest point, and was obstructed by submerged bowlders.

The project of improvement was adopted in 1881. Its design was to cut a channel 14 feet deep through a neck of land between the river and the lake at a point about 2,000 feet south of the river mouth, and to continue this channel to deep water in the lake by the construction of two parallel piers 200 feet apart, extending from each side of the cut lakeward to the 18-foot contour.

The total amount expended on this harbor up to the close of the fiscal year ending June 30, 1890, was $54,777.37, in addition to which the local harbor commissioners had expended $8,042.72. At that time 1,000 feet of the north pier and 1,075 feet of the south pier had been constructed, and a channel 60 feet wide and 12 feet deep had been dredged, 133,291 cubic yards of material having been removed by the Government dredges.

During the fiscal year ending June 30, 1891, $9,107.77 has been expended in dredging 77,790 cubic yards of material from the channel.

Extension of the pier under contract dated December 13, 1890, is in progress.

July 1, 1890, balance unexpended	$188.23
Amount appropriated by act approved September 19, 1890	20,000.00
	20,188.23
June 30, 1891, amount expended during fiscal year	9,107.77
July 1, 1891, balance unexpended	11,080.46
July 1, 1891, amount covered by uncompleted contracts	10,000.00
July 1, 1891, balance available	1,080.46

Amount (estimated) required for completion of existing project	116,957.28
Amount that can be profitably expended in fiscal year ending June 30, 1893	75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 10.)

11. *Two Rivers Harbor, Wisconsin.*—Previous to the improvement of this harbor the natural channel was obstructed by a bar covered by but 2 or 3 feet of water.

The project of improvement adopted in 1870 provided for the formation of a channel of navigable width and not less than 12 feet deep, to be accomplished by the construction of two piers extending from the mouth of Two Rivers lakeward to the 18-foot contour in Lake Michigan and dredging a channel between them.

The amount expended up to the close of the fiscal year ending June 30, 1890, was $199,948.59, resulting in the construction of two parallel piers, as follows: A north pier 1,810 feet long, the inner 1,060 feet of which consists of pile pier, and the outer 750 feet of crib pier; a south pier 1,710 feet long, 960 feet of which is pile pier, and the outer 750 feet crib pier; the crib sections of the two piers begin at points opposite each other and are 230 feet apart; the pile sections are 270 feet apart; 253,372 cubic yards of material has been removed by dredging.

During the fiscal year ending June 30, 1891, $2,690.43 has been ex-

pended in bulkhead protection to the ends of the piers and in the removal of 22,495 cubic yards of material from the channel.

July 1, 1890, balance unexpended		$551.41
Amount appropriated by act approved September 19, 1890		3,000.00
		3,551.41
June 30, 1891, amount expended during fiscal year		2,690.43
July 1, 1891, balance unexpended		860.98
Amount (estimated) required for completion of existing project		62,088.80
Amount that can be profitably expended in fiscal year ending June 30, 1893		6,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 11.)

12. *Manitowoc Harbor, Wisconsin.*—Previous to the improvement of this harbor but 3 feet of water existed at the shoalest point over the bar at the mouth of the Manitowoc River.

The original project adopted in 1852 provided for the construction of two parallel piers, 220 feet apart, extending from the mouth of the river to the 12-foot contour in Lake Michigan. In 1881 this was modified so as to secure a deeper channel by extending the piers to a depth of 18½ feet and dredging to not less than 14 feet.

The total amount expended up to June 30, 1890, was $299,112.39, resulting in the construction of two piers, the north one 1,970 and the south one 1,900 feet long, 228 feet apart at the shore line and 250 feet at the outer ends, and in the removal of 184,997 cubic yards of material by dredging.

During the fiscal year ending June 30, 1891, $3,694.02 has been expended in rebuilding 400 feet of superstructure of the north pier and in dredging 9,464 cubic yards of material from the channel.

July 1, 1890, balance unexpended		$759.61
Amount appropriated by act approved September 19, 1890		8,000.00
		8,759.61
June 30, 1891, amount expended during fiscal year		3,694.02
July 1, 1891, balance unexpended		5,065.59
July 1, 1891, outstanding liabilities	$930.93	
July 1, 1891, amount covered by uncompleted contracts	3,333.64	
		4,264.57
July 1, 1891, balance available		801.02
Amount (estimated) required for completion of existing project		40,362.54
Amount that can be profitably expended in fiscal year ending June 30, 1893		*48,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 12.)

13. *Sheboygan Harbor, Wisconsin.*—Previous to the improvement of this harbor the natural channel had a depth not exceeding 4 feet on the bar at the entrance of the river.

The original project for the improvement of this harbor was adopted in 1852 and had for its object the formation of a 12-foot channel entrance to the mouth of the Sheboygan River. This was modified in 1873 so as to secure a deeper channel by further pier extension and dredging. Both projects were completed within their estimated cost and a channel

*This amount includes $8,000 required for preservation of piers and for maintenance of channel.

was formed 100 feet wide with a depth of 15 to 16 feet between the piers. This was further modified in 1881, the present project having for its object to deepen the channel still further by extending the piers to the 20-foot contour in the lake and dredging to a depth of 18 feet between their outer ends, the depth decreasing to 14 feet at the shore line.

The total expenditures up to June 30, 1890, amounted to $302,157.82, resulting in the construction of a north and a south pier, 2,044 and 2,260 feet long, respectively, and the removal by dredging of 207,193 cubic yards of material. There was then a navigable channel 14 feet deep.

During the fiscal year ending June 30, 1891, $3,705.46 has been expended in dredging 25,325 cubic yards of material and in riprapping and refilling the south pier.

July 1, 1890, balance unexpended	$1,230.89
Amount appropriated by act approved September 19, 1890	15,000.00
	16,230.89
June 30, 1891, amount expended during fiscal year	3,705.46
July 1, 1891, balance unexpended	12,525.43
July 1, 1891, amount covered by uncompleted contracts	10,000.00
July 1, 1891, balance available	2,525.43
Amount (estimated) required for completion of existing project	67,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	67,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 13.)

14. *Port Washington Harbor, Wisconsin.*—The natural channel at the mouth of the Sauk River was narrow and at the shoalest point had a depth of but 1 foot.

The original project for the improvement of this harbor was adopted in 1869 and provided for two parallel piers extending to 10 feet of water in Lake Michigan and the excavation of an interior basin. This plan was modified in 1870 and again in 1876, and now provides for the excavation of two interior basins with a combined area of $5\frac{3}{4}$ acres, with a depth of 12 feet, and a channel of the same depth connecting the basins with the lake.

The total expenditure up to June 30, 1890, was $172,468.95, and resulted in the construction of a north and south pier, respectively, 920 and 1,226 feet long, with 400 feet of revetment along the north bank of the river, extending to the inner end of the south pier; in the formation of two interior dredged basins of $2\frac{3}{4}$ and 3 acres, respectively, with an average depth of about 9 feet in the north and 8 feet in the west basin, and in making a navigable channel between the piers of 11 feet; 282,219 cubic yards of material was removed by dredging.

During the fiscal year ending June 30, 1891, $2,004.25 has been expended in dredging 9,485 cubic yards of material from channel entrance and basins; the north basin has the required depth of 12 feet over nearly its entire area; the south basin, a depth of 8 feet, with a narrow channel of 12 feet on its north side, and the channel entrance, a depth of 12 feet for a width of 80 feet.

July 1, 1890, balance unexpended	$2,038.95
Amount appropriated by act approved September 19, 1890	3,000.00
	5,038.95
June 30, 1891, amount expended during fiscal year	2,004.25
July 1, 1891, balance unexpended	3,034.70

Amount (estimated) required for completion of existing project	$6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 14.)

15. *Harbor of refuge at Milwaukee Bay, Wisconsin.*—The project for the work was approved in 1881 and contemplated the formation of an artificial harbor by inclosing a portion of Lake Michigan, forming Milwaukee Bay within an outer breakwater of cribwork upon a stone foundation. This harbor will furnish 417 acres of safe mooring ground beyond the 18-foot contour and about twice this area beyond the 12-foot contour.

The actual length of the breakwater when completed will be 7,250 feet.

Work began in 1881, and up to June 30, 1890, there had been expended $394,901.72, resulting in the completion of 3,650 feet of substructure and 3,100 feet of superstructure, leaving 3,600 feet of the former and 4,150 feet of the latter to complete the work.

During the fiscal year ending June 30, 1891, $9,220.09 has been expended in repairing damages caused by the steamer *City of Traverse* running into the breakwater and the damages caused by winter storms.

The harbor is now used to a considerable extent as a shelter from northeast storms, and its value will rapidly increase as the breakwater is extended.

July 1, 1890, balance unexpended		$9,298.85
Amount appropriated by act approved September 19, 1890		80,000.00
		89,298.85
June 30, 1891, amount expended during fiscal year		9,220.09
July 1, 1891, balance unexpended		80,078.76
July 1, 1891, amount covered by uncompleted contracts		70,000.00
July 1, 1891, balance available		10,078.76
Amount (estimated) required for completion of existing project	309,737.91	
Amount that can be profitably expended in fiscal year ending June 30, 1893	200,000.00	
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 15.)

16. *Milwaukee Harbor, Wisconsin.*—The original depth of water at the mouth of the Milwaukee River was not more than 3½ feet.

The original project was adopted in 1852, and was directed to securing 12 feet of water at the entrance to the river and to protecting the channel by parallel piers. In 1868 this was modified so as to secure a channel 18 feet deep, by extending the piers 600 feet and dredging. The project has been completed, and consequently the only expenditures now demanded are for the maintenance of the piers by timely repairs and of the depth of the channel by dredging.

Up to the close of the fiscal year ending June 30, 1890, there had been expended on this harbor $298,843.95, in addition to $321,355.66 expended by the city of Milwaukee, resulting in the completion of the modified project of 1868.

During the fiscal year ending June 30, 1891, $192 has been expended in contingent expenses. Proposals have been invited for removing about 26,000 cubic yards of material from the channel between the piers to restore it to its depth of 18 feet.

July 1, 1890, balance unexpended	$742.13
Amount appropriated by act approved September 19, 1890	6,000.00
	6,742.13
June 30, 1891, amount expended during fiscal year	192.00
July 1, 1891, balance unexpended	6,550.13
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	14,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 16.)

17. *Racine Harbor, Wisconsin.*—The entrance to this harbor originally varied in depth from absolute closure after storms to about 6 feet.

The original project was adopted in 1842 or 1843 and contemplated a channel 12 feet deep. In 1866 the project was modified to providing a channel 15 feet deep.

There has been expended on this harbor up to June 30, 1890, $241,762.91, resulting in the construction of a north and south pier 1,460 and 1,070 feet long, respectively, and a dredged channel 16 feet deep.

During the fiscal year ending June 30, 1891, $399.71 has been expended. Four thousand and eighty-nine cubic yards of material has been removed from the channel under an agreement calling for the restoration of the channel by the removal of 14,000 cubic yards.

The constant shoaling at the entrance to this harbor shows that the piers will have to be extended several hundred feet in order to maintain the intended depth. Some 500 feet of the superstructure of the piers should be rebuilt.

July 1, 1890, balance unexpended	$543.59
Amount appropriated by act approved September 19, 1890	17,500.00
	18,043.59
June 30, 1891, amount expended during fiscal year	399.71
July 1, 1891, balance unexpended	17,643.88
July 1, 1891, amount covered by uncompleted contracts	14,000.00
July 1, 1891, balance available	3,643.88
Amount (estimated) required for completion of existing project	64,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix L L 17.)

18. *Kenosha Harbor, Wisconsin.*—The original depth of water at the mouth of Pike Creek varied from absolute closure to 3 feet.

The original plan of improvement was adopted in 1852 and was directed to securing a channel 12 feet deep by constructing parallel piers and dredging between them. This plan was modified in 1866 so as to secure 15 feet of water by extending the piers and dredging deeper.

There was expended upon this harbor up to June 30, 1890, $228,018.34, resulting in the construction of two piers, north and south, 1,600 and 800 feet in length, respectively, 150 feet apart, with a channel of varying depth. In 1875 and 1876 the channel was dredged to 15 feet, but the subsequent appropriations have not been sufficient to maintain this

depth, so that the periodical dredging has only provided an available channel of about 12 feet.

During the fiscal year ending June 30, 1891, $2,886.20 has been expended, of which $2,500 was spent in dredging the inner harbor in accordance with a clause in the river and harbor act of September 19, 1890; an area of about 3 acres was dredged to a depth of 14 feet, about 21,000 cubic yards of material being removed; 5,400 cubic yards was dredged from the channel and good progress made in the pier extension under contract.

July 1, 1890, balance unexpended		$1,435.23
Amount appropriated by act approved September 19, 1890		17,500.00
		18,935.23
June 30, 1891, amount expended during fiscal year		2,886.20
July 1, 1891, balance unexpended		16,049.03
July 1, 1891, outstanding liabilities	$1,151.47	
July 1, 1891, amount covered by uncompleted contracts	10,000.00	
		11,151.47
July 1, 1891, balance available		4,897.56
Amount (estimated) required for completion of existing project		64,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 18.)

19. *Waukegan Harbor, Illinois.*—Previous to improvement there was no navigable channel or natural harbor at this place, the adopted project contemplating the construction of an artificial harbor.

A project was adopted in 1852 which provided for the construction of a breakwater parallel to the shore in 20 feet of water. One crib was placed in position but was carried away by a storm, and the work was then abandoned. In 1872 another project was submitted for a breakwater in 24 feet of water. No action was taken on this.

The present project was adopted in 1880, and provides for the construction of an exterior basin of sufficient capacity for local trade by inclosing a portion of Lake Michigan with pile piers, the entrance channel between the piers and the inclosed area to be dredged to 12 feet.

There has been expended on this harbor up to the close of the fiscal year ending June 30, 1890, $110,916.38, resulting in the construction of 2,285 feet of pile pier and the removal of 80,874 cubic yards of material.

During the fiscal year ending June 30, 1891, $13,556.82 has been expended in repairs to pile-driver, purchase of materials and extension of north pier, 192 linear feet of this extension being completed at the close of the fiscal year.

July 1, 1890, balance unexpended		$4,083.62
Amount appropriated by act approved September 19, 1890		35,000.00
		39,083.62
June 30, 1891, amount expended during fiscal year		13,556.82
July 1, 1891, balance unexpended		25,526.80
July 1, 1891, outstanding liabilities		2,247.95
July 1, 1891, balance available		23,278.85
Amount (estimated) required for completion of existing project		86,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix L L 19.)

20. *Fox and Wisconsin rivers, Wisconsin.*—The works for the improvement of the Fox and Wisconsin rivers were purchased by the United States from the Green Bay and Mississippi Canal Company in 1872. With the exception of one stone lock they were all temporary structures and were in bad condition. There was no low-water navigation on the Upper Fox, and on the Lower Fox navigation was uncertain.

The adopted project for the improvement of the Fox River contemplated the replacing of the temporary structures with permanent works, the construction of five additional stone locks on the upper river, and widening and deepening the channels throughout the river and canals to 6 feet depth and 100 feet width.

The method adopted for the Wisconsin River was to contract the channel way by stone and brush wing dams, in order to give increased depth by concentration and scour.

The estimate for both rivers, made in 1874 and 1876, was $3,745,663.

The general project of the improvement of the Fox and Wisconsin rivers was referred to the Board of Engineers, who, after systematic observations of the effect of the dams on the improved section of the Wisconsin River, submitted a report, contained in House Ex. Doc. No. 65, Forty-ninth Congress, second session, recommending that no further work be done on wing dams in the Wisconsin River with a view to improving its navigation.

The original project, therefore, as far as it relates to the Wisconsin River, has been abandoned, and the work confined to the Fox River, under the modified project of a Board of Engineers, submitted September 17, 1884, published in the Annual Report of the Chief of Engineers for 1885, approved by the Secretary of War, December 10, 1885, as further modified by authority of the Chief of Engineers, May 14, 1886.

The modified project applies only to the Fox River and its needs, and provides for the renovation of eleven old locks and the deepening and widening of the channel of the Fox River from Montello to Green Bay to 6 feet depth and 100 feet width, and that from Portage to Montello 4 feet of water at low water be maintained, the estimate for which was $602,000.

The amount expended on the Fox and Wisconsin rivers from 1867 up to the close of the fiscal year ending June 30, 1890, including outstanding liabilities and $145,000 paid to the Green Bay and Mississippi Canal Company for works of improvement under act of June 10, 1872, was $2,942,752.18.

The result of this expenditure was:

On the Fox River.—The construction of 14 new locks of stone; 17 dams, 4 of which are temporary; 12 cutoffs; 10 miles of canals dredged and deepened. Over 2,000,000 cubic yards of material were dredged from the Upper Fox, and all temporary structures repaired and maintained in working order.

Throughout the season of 1890 navigation was continuous with the exception of 17 days in July and August, when it was suspended through the fourth lock at Appleton in consequence of repairs necessitated by the carrying away of the upper gates by a steamer running into them.

Under the modified project there remains to be done 2,800,000 cubic yards of dredging and rock excavation, mainly on the Upper Fox.

On the Wisconsin River.—One hundred and eight thousand five hundred and twelve linear feet of wing dams had been constructed over a distance of 50 miles, of which a section 9.2 miles in length below Portage had been completed. The result was an increased depth of navi-

gation wherever the works had been applied. On account of the shifting nature of the sand bars there was never any regular navigation on the river.

During the fiscal year ending June 30, 1891, $39,059.54 has been expended and the following work done:

A head wall and feeder at the old first lock at Appleton, a wing dam of brush and stone as a shore protection to the Portage Levee, a new tugboat and 2 dump scows built, channels dredged at Grignon Rapids, mouth of the Fond du Lac River, and between De Pere and Green Bay.

July 1, 1890, balance unexpended	$15,556.01
Amount appropriated by act approved September 19, 1890	100,000.00
	115,556.01
June 30, 1891, amount expended during fiscal year	39,059.54
July 1, 1881, balance unexpended	76,496.47
July 1, 1891, outstanding liabilities	2,990.52
July 1, 1891, balance available	73,505.95
Amount (estimated) required for completion of existing project	346,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	200,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix L L 20.)

21. *Operating and care of locks and dams on Fox River, Wisconsin.*—Under the continuous appropriation for operating and care of canals and other works of navigation, it is proposed to maintain existing navigation by timely repairs to old locks until they are replaced by new, and to continue repairs of works that have already been completed and used, injured by floods or otherwise.

The amount expended under the indefinite appropriation provided by section 4 of the river and harbor act of July 5, 1884, up to the end of the fiscal year ending June 30, 1890, was $308,779.71.

During the fiscal year ending June 30, 1891, $68,989 has been expended, the detailed statement appended to the report of the local engineer officer showing the items of expenditure.

June 30, 1891, amount expended during fiscal year	$68,989.00
Amount (estimated) for expenditure in fiscal year ending June 30, 1892	63,998.29

(See Appendix L L 21.)

IMPROVEMENT OF CHICAGO AND CALUMET HARBORS, ILLINOIS, OF CALUMET RIVER, ILLINOIS AND INDIANA, AND OF ILLINOIS RIVER, ILLINOIS; ILLINOIS AND MISSISSIPPI CANAL.

Officer in charge, Capt. W. L. Marshall, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Chicago Harbor Illinois.*—The present project was adopted in 1870 and modified in 1878, and contemplates:

a. The formation of an outer harbor or basin, by inclosing a portion of Lake Michigan just south of and adjoining the entrance to Chicago River, for the purpose of increasing the harbor facilities of Chicago.

b. The construction of an exterior breakwater in deep water north of the entrance to Chicago River and about 1 mile distant, to shelter the approach to the river and outer harbor entrance, and to form a harbor of refuge at the southern end of Lake Michigan.

There has been expended upon this project since 1870 $1,616,435.52, which expenditure has resulted—

In the completion of the outer harbor, except 267,000 cubic yards of dredging, to attain 16 feet of water at low water throughout the required basin.

In the completion of the exterior breakwater 5,413 feet in length; in keeping the entrance to Chicago Harbor dredged; in maintaining the various piers and breakwaters, and in maintaining in serviceable condition the plant pertaining to the work.

During the past fiscal year the work consisted in—

a. Exterior breakwater.—In placing a heavy decking over about two-thirds of the width of the exterior breakwater, composed mainly of material on hand suitable for no other purpose.

b. Outer Basin and North Pier, Chicago Harbor.—Under contract rebuilding superstructure over easterly breakwater, outer basin, and north pier, Chicago Harbor, was commenced, and at the close of the fiscal year about 1,700 linear feet of superstructure over easterly breakwater, except decking and stone filling, had been completed. This work includes 749,240 feet B. M., pine timber, and 70,573 pounds iron drift bolts, placed in the work.

The superstructure over the southerly breakwater, outer basin, and for about 1,225 feet of south pier, entrance to Chicago River, now needs renewal, and there is 267,000 cubic yards of dredging needed to complete the outer basin.

The outer basin has never fulfilled the purposes of its construction on account of the litigation that has existed for many years as to the riparian ownership along the lake front, and the dredging in that basin may well be postponed until the lake front is in demand for harbor and dock purposes, when the material will be valuable for filling docks.

July 1, 1890, balance unexpended		$17,565.17
Amount deposited to credit of appropriation by Quartermaster's Department (fuel account)		27.65
Amount appropriated by act approved September 19, 1890		100,000.00
		117,592.82
June 30, 1891, amount expended during fiscal year		21,589.62
July 1, 1891, balance unexpended		96,003.20
July 1, 1891, outstanding liabilities	$1,500.00	
July 1, 1891, amount covered by uncompleted contracts	76,835.38	
		78,335.38
July 1, 1891, balance available		17,667.82
Amount (estimated) required for completion of existing project		72,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		72,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix M M 1.)

2. *Calumet Harbor, Illinois.*—This improvement is to furnish a safe and practicable entrance to Calumet River and the port of South Chicago, by parallel piers, 300 feet apart, extending from shore to deep water in the lake, and by dredging between them to 16 feet in depth at low water.

The work commenced in 1870, and at the close of the fiscal year 1891 there had been expended $411,457.46, as the result of which 3,640 linear feet of the North Pier and 2,020 linear feet of the South Pier have been completed and 413,434 cubic yards of material dredged, giving a channel 16 feet in depth instead of 7 feet, as originally existed.

During the past fiscal year under contract for dredging 29,088 cubic yards of material has been removed from the channel, which had de-

teriorated in width and depth. The work of dredging will probably be completed before the close of the season of navigation 1891, and will give a channel 250 feet wide, 16 feet deep at low water from Lake Michigan to similar depth of water in Calumet River.

The superstructures of parts of the piers to this harbor are in a deplorable state of decay, so reported for several years. The work of time continues, and now there is a length of 2,000 linear feet, more or less, of pier-work superstructure that is worthless, and 800 feet more in bad condition. The 2,000 feet should be immediately renewed, and the estimate herewith is for work of maintenance entirely.

The contract for dredging having been made at 50 per cent. less than the estimates, the dredging will be completed under the last appropriation and the present contract.

July 1, 1890, balance unexpended	$4,182.24
Amount appropriated by act approved September 19, 1890	20,000.00
	24,182.24
June 30, 1891, amount expended during fiscal year	3,251.70
July 1, 1891, balance unexpended	20.930.54
July 1, 1891, amount covered by uncompleted contracts	9,691.20
July 1, 1891, balance available	11,239.34
Amount (estimated) required for maintenance	32,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	32,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 2.)

3. *Calumet River, Illinois and Indiana.*—The object of this improvement, so far as at present projected, is to secure a channel 200 feet in width and 16 feet in depth below low-water plane in Lake Michigan, from the mouth of the Calumet River at Calumet Harbor, Illinois, to one-half mile east of Hammond, Ind., with a view to increasing the facilities for handling the growing commerce of this region and also to aid in providing means for the better accommodation of much of the commerce of Chicago River, which is now very much crowded. The original depth of navigation in this river varied from 6 to 10 feet.

The various acts of Congress and the limitations made by law upon the expenditure of the appropriation thereby made are stated in the Annual Report, Chief of Engineers, for the year ending June 30, 1889.

At the beginning of the last fiscal year work was in progress under contract with the lowest responsible bidder for dredging *between the mouth and One hundred and eighth street*—W. A. McGillis & Co., Havana, Ill., now of South Chicago, Ill.

During the past fiscal year this contract has been completed. Originally it expired November 30, 1889, but subsequent extensions were granted to November 30, 1890.

Under this contract 771,737 cubic yards of material was removed from the channel, of which amount 393,112 cubic yards was removed during the past fiscal year.

Under the last river and harbor act approved September 19, 1890, and under contract, 72,111 cubic yards of material has been removed from the channel.

The existing contract will carry the work from One hundred and eighth to near One hundred and thirteenth street.

The work has met opposition, as shown by the ejectment suit of A. A. Westengard, who claims to own submerged lots lying within the

original meandered line of the Calumet River, and part of which lie under the deepest channel of Calumet River. The matter is in the hands of the district attorney for the northern district of Illinois, to protect the interests of the United States.

No work has been done during the fiscal year upon the section of the Calumet River between the forks and one-half mile east of Hammond, Ind.

The amount expended by the United States to the close of the fiscal year ending June 30, 1891, is $135,598.33, of which $109,904.58 has been expended between the mouth of the Calumet River and One hundred and eighth street, including $5,000 paid for legal expenses in securing rights of way and releases from damage claims, required by the act of July 5, 1884, and $25,693.75 for work between the forks of the Calumet and one-half mile east of Hammond, Ind.

The funds now on hand will be applied to continuing the work under existing contract and to forwarding towards completion the approved project.

The funds asked for are to be applied in the same direction.

July 1, 1890, balance unexpended	$51,790.28
Amount appropriated by act approved September 19, 1890	50,000.00
	101,790.28
June 30, 1891, amount expended during fiscal year	57,388.91
July 1, 1891, balance unexpended	44,401.37
July 1, 1891, amount covered by uncompleted contracts	41,172.26
July 1, 1891, balance available	3,229.11

Amount (estimated) required for completion of existing project	820,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix M M 3.)

4. *Illinois River, Illinois.*—The present project contemplates the extension of the work heretofore done by the State of Illinois from the mouth of Copperas Creek to the Mississippi River, a distance of about 135 miles, which project includes the building of two locks 350 feet long between miter sills, 75 feet in width of lock chamber, with 7 feet of water over the miter sills at low-water level of 1879, and dredging the channel where necessary to attain 7 feet depth at low water in the pools thus created.

The sites selected for the two locks are one at Kampsville, 31 miles above the mouth of the Illinois, the other at La Grange, 79 miles above the mouth of the river.

The ultimate object of the improvement is the construction of a ship canal from the southern end of Lake Michigan to the Mississippi River of sufficient capacity to accommodate large-sized Mississippi River steamboats and for military and naval purposes.

The State of Illinois, aided by the United States, has executed part of the project by the construction of two locks of the dimensions above stated, one at Henry and one at Copperas Creek, respectively, completing, except dredging, that part of the improvement between La Salle, Ill., and the mouth of Copperas Creek.

The La Grange Lock and Dam are practically completed and in use. The foundation of the Kampsville Lock is completed, and all the stone required for its construction is on hand, piled at the lock site, except a

small amount to be delivered during the present calendar year under contract.

There is still to be done under this project the following work:

At the La Grange Lock, some 2,500 cubic yards of riprap to be placed below the dam to protect the river bottom against scour, a short pile revetment to be built as a guide to vessels at the head of the lock, and the grading and cleaning up around the buildings to be completed.

The greater part of this work will be done by the regular lock force.

The Kampsville Lock and Dam to be completed, and about 2,000,000 cubic yards of dredging in the pools.

In executing this work the United States has expended up to June 30, 1891, including $25,000 expended from the appropriation of August 11, 1888, for surveys, and exclusive of $62,359.80 expended upon the foundation of the Copperas Creek Lock, afterwards completed by the State of Illinois, the sum of $962,919.12.

An additional amount of $747,747 was expended by the State of Illinois on Henry and Copperas Creek locks.

During the fiscal year ending June 30, 1890, the following work was done:

a. La Grange Lock.—A pile revetment 307 feet in length was built below the lock along the bank and another revetment 265 feet in length below the abutment of the dam; 275 linear feet of old coffer-dam removed; lock-keeper's house provided with eaves, drain, and cistern; filling behind the land wall of the lock practically completed; valve gearing of the lock overhauled and replaced with more powerful gearing for the lower gates; the lock reservation was fenced.

b. La Grange Dam.—The part of the dam, 170 linear feet in length, left incomplete the previous season, was filled with stone and coped, and 1,800 cubic yards of stone placed below the dam to prevent scour.

The dam was backed with 15,213 cubic yards dredged material.

c. Kampsville Lock.—Quarters for laborers in building the lock were built, 25,114 cubic yards of mud dredged off the foundation of the lock, and necessary preparations made to begin the laying up of the masonry of this lock at an early date. No stone has been delivered at Kampsville during the past fiscal year, but it is all under contract.

The plant has been repaired and maintained in serviceable condition, but all hulls of floating property have become almost irreparable from decay.

July 1, 1890, balance unexpended		$5,033.25
Amount appropriated by act approved September 19, 1890		200,000.00
		205,033.25
June 30, 1891, amount expended during fiscal year		45,728.82
July 1, 1891, balance unexpended		159,304.43
July 1, 1891, outstanding liabilities	$2,500.00	
July 1, 1891, amount covered by uncompleted contracts	23,901.04	
		26,401.04
July 1, 1891, balance available		132,903.39
Amount (estimated) required for completion of existing project		212,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		212,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix M M 4.)

5. *Operating and care of La Grange Lock, Illinois River, Illinois.*—This lock has been maintained and operated under the general indefinite

appropriation for "operating and care of canals and other works of navigation" contained in the river and harbor act of July 5, 1884, section 4. The approaches to the lock have been kept dredged and the lock maintained in serviceable condition by necessary changes and repairs to operating machinery, gates, and valves.

Twenty-one thousand seven hundred and fifty-nine cubic yards of dredging was done, the material being placed behind the lock wall and as backing for the dam.

During the year 985 lockages were made, the lockages of steam vessels showing an increase of 44 per cent. over the previous year.

The amount expended during the fiscal year was $9,275.03.

July 1, 1890, amount available	$10,720.00
June 30, 1891, amount expended during fiscal year	9,275.03
July 1, 1891, balance unexpended	1,444.97
July 1, 1891, outstanding liabilities	834.47
July 1, 1891, balance available	610.50

(See Appendix M M 5.)

6. *Illinois and Mississippi Canal.*—The object of this improvement is to furnish a link in a navigable water route from Lake Michigan, at or near Chicago, Ill., to the Mississippi River, at the mouth of Rock River.

The canal is located upon the route approved by the Secretary of War, October 27, 1888, from the Illinois River, about $1\frac{3}{4}$ miles above the town of Hennepin, at the great bend of the Illinois River, thence via Bureau Creek Valley to Rock River at Penney Slough, thence by slackwater and a short canal around the lower rapids in Rock River to its mouth.

The canal is to be 80 feet wide at the water surface, 7 feet deep, and with locks 170 feet in length, 35 feet in width of lock chamber.

A report upon the detailed location, plans, and estimates for the construction of this canal was submitted June 21, 1890, and published by Congress as House Ex. Doc. No. 429, Fifty-first Congress, first session.

The river and harbor act of September 19, 1890, made the first appropriation for the construction of this canal, and directed work to be begun by the construction of one of the locks and dams in Rock River.

During the past fiscal year detailed surveys for the accurate location on the ground for the works for the passage of the lower rapids in Rock River at Milan were inaugurated and completed, legal plats and descriptions of all lands required for the construction of the lower 4 to 5 miles of the canal obtained, voluntary agreements entered into for the purchase of lands as far as practicable, and detailed estimates made for this part of the work.

Work will begin as soon as the necessary legal titles to lands and sites have been acquired by the United States.

This matter is now in the hands of the Department of Justice.

In view of the necessary delay in acquiring rights of way and to the fact that, under present methods of appropriation, titles to land are acquired for only such parts of the work as can be done under the current appropriation, the actual work of construction must lag an indefinite time after money becomes available.

It is advisable, if practicable, that provision should be made for the continuous prosecution and completion of the work, or at least that title be acquired for the actual location upon the most favorable ground of the work throughout its length in order that work may be continuous.

Under this view an estimate of $200,000, to be expended, as needed, for the necessary expenses of acquiring title to the right of way of the canal throughout, is submitted, and a further estimate of $1,500,000 for actual work of construction along such right of way.

July 1, 1890, balance unexpended	$152.80
Balance available, act August 2, 1882	633.66
Amount appropriated by act approved September 19, 1890	500,000.00
	500,786.46
June 30, 1891, amount expended during fiscal year	11,755.36
July 1, 1891, balance unexpended	489,031.10
July 1, 1891, outstanding liabilities	100.00
July 1, 1891, balance available	488,931.10
Amount (estimated) required for completion of existing project	6,425,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,700,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix M M 6.)

EXAMINATION AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Illinois River, Illinois, from La Salle to the Mississippi River, as recommended by Capt. W. L. Marshall, corps of engineers, in his report dated March* 10, 1890, *with a view to ascertaining what lands would be subject to overflow by the construction of a navigable water way between Lake Michigan and the Mississippi River*, was made by the local engineer in charge, Captain Marshall, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Captain Marshall, and of the Division Engineer, based upon the facts and reasons given, that this river is worthy of improvement, and that the amount, $25,000, allotted by the act for the purpose should be applied to the survey of the river. This opinion being concurred in by me, Captain Marshall was charged with the survey and submitted report thereon.

Captain Marshall states that the damages by flowage under any project by the United States Government for a water way via the Illinois River are already known to be insignificant, and that no further surveys to determine them are needed. The survey referred to in the report cited was recommended in view of the proposed use of the water way under laws of the State of Illinois for an artificial discharge for sewage-disposal purposes and in view of the lands that would be subject to overflow by such use of the river. The cost of this survey was estimated at $250,000, and the allotment of $25,000 made by the act of September 19, 1890, for the purpose, is entirely inadequate. This amount ($25,000) can be expended to advantage in carrying a line of precise levels from the Mississippi River to the Great Lakes, to serve as a basis for the survey indicated; also in making a hydrographic survey of the pools of the Illinois River, to ascertain the amount of dredging required to complete the existing project of improvement and to form part of the more extended survey; but, before making such uses of this fund, it is deemed advisable to further submit the matter to Congress, in order that such use may be

authorized, or provision made for sufficient funds to carry the survey to completion. (See Appendix M M 7.)

IMPROVEMENT OF RIVERS AND HARBORS ON EASTERN SHORE OF LAKE MICHIGAN.

Officer in charge, Maj. William Ludlow, Corps of Engineers; Division Engineer, Col. O. M. Poe, Corps of Engineers.

1. *Petoskey Harbor, Michigan.*—The act of September 19, 1890, appropriated $15,000 towards the construction of a "breakwater and harbor of refuge" at this place pursuant to a project the estimated cost of which was $170,000. The amount being insufficient to accomplish any useful result, it is held, by authority of the Secretary of War, to await further action by Congress.

Amount appropriated by act approved September 19, 1890	$15,000.00
July 1, 1891, balance unexpended	15,000.00
Amount (estimated) required for completion of existing project	155,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 1.)

2. *Charlevoix Harbor and entrance to Pine Lake, Michigan.*—The harbor of Charlevoix occupies the peninsula between Grant and Little Traverse bays, and gives access to Pine Lake, a large and navigable body of water extending 12 or 15 miles into the land.

The original entrance depth was from 2 to 6 feet. The project of 1868, revised in 1876, calls for 12-foot draft between piers, 100 feet to 150 feet apart, and for the upper channel between Round and Pine Lakes 83 feet width. The expenditures to July 1, 1890, were $91,764.09. The piers are not yet fully extended to the 15-foot contour in the lake. At the opening of navigation in the spring of 1891 the available draft was about 11 feet.

The expenditure for the fiscal year was $4,505.71. The harbor was dredged in July and August, 1890, 50 feet wide and 15 feet deep. May 10 to June 22, 1891, the entrance was again dredged to 15 feet and the upper channel deepened to 13 feet. The total amount dredged was 33,500 cubic yards. June 1, 1891, repairs were begun to the revetments of the upper channel and were nearly completed at the close of the year.

July 1, 1890, balance unexpended		$1,735.91
Amount appropriated by act approved September 19, 1890		9,000.00
		10,735.91
June 30, 1891, amount expended during fiscal year		4,505.71
July 1, 1891, balance unexpended		6,230.20
July 1, 1891, outstanding liabilities	$1,359.16	
July 1, 1891, amount covered by uncompleted contracts	1,571.47	
		2,930.63
July 1, 1891, balance available		3,299.57
Amount (estimated) required for completion of existing project		83,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		46,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 2.)

3. *Frankfort Harbor, Michigan.*—The natural channel through the beach between Lake Michigan and Lake aux Becs Scies was about 3 or 4 feet deep, and the project of 1866, revised in 1868 and 1879, was to make a 12-foot channel between piers and revetments 200 feet apart.

The expenditures to July 1, 1890, were $257,339.52. The piers still lack their full extension, and to reach the 15-foot contour must project still further.

The expenditures for the fiscal year 1891 were $2,542.75.

The harbor was dredged August 1 to 14, 1890, and surveys made May, 1891, showed a navigable depth of 10 feet between the piers and 9 feet on the bar outside them.

The estimate for 1893 contemplates the construction of 6 new cribs on the north pier, repairs of existing works, and dredging.

July 1, 1890, balance unexpended	$598.83
Amount appropriated by act approved September 19, 1890	10,000.00
	10,598.83
June 30, 1891, amount expended during fiscal year	2,542.75
July 1, 1891, balance unexpended	8,056.08
July 1, 1891, amount covered by uncompleted contracts	1,455.32
July 1, 1891, balance available	6,600.76
Amount that can be profitably expended in fiscal year ending June 30, 1893	32,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 3.)

4. *Harbor of refuge at Portage Lake, Michigan.*—The project of 1879 was to provide a harbor of refuge for general commerce by constructing an entrance 400 feet wide and 18 feet deep through the sand spit into Portage Lake, a capacious body of water lying conveniently for the purpose between Point Betsey and Big Sable. The work has dragged along with insufficient appropriations without attaining the object sought until the incomplete works are falling down from decay and the entrance is chronically choked with sand. The work is one of value to lake commerce, and should be pushed to completion or the project materially modified.

The expenditures to July 1, 1890, were $90,051.81, and for the fiscal year, $2,990.04.

The entrance was dredged August 4 to September 6, with a width of 70 feet and depth of 13½ feet, but in May, 1891, it had again nearly closed to 8 or 9 feet.

A light-house has been constructed on the outer end of the north pier.

July 1, 1890, balance unexpended	$2,448.19
Amount appropriated by act approved September 19, 1890	8,000.00
	10,448.19
June 30, 1891, amount expended during fiscal year	2,990.04
July 1, 1891, balance unexpended	7,458.15
July 1, 1891, amount covered by uncompleted contracts	1,913.08
July 1, 1891, balance available	5,545.07
Amount (estimated) required for completion of existing project	167,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	125,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 4.)

5. *Manistee Harbor, Michigan.*—As originally improved, at local cost, by the building of rough slab piers, the channel at the mouth of the Manistee River, which is the outlet for Manistee Lake, had 7 or 8 feet of water. The project of 1867, revised in 1871, 1873, and 1875, provided for 12 feet depth, and as again revised in 1890, increased the depth to 15 feet and extended it to connect with Manistee Lake, a distance of 8,000 feet.

The expenditures to July 1, 1890, were $243,467.86, practically completing the 12-foot project. The dredging and pier extension for the 15-foot project adds $115,000 to the total cost.

The expenditure for the past year was $19,441.20. Dredging in the river began in November, 1890, and continued to January 30; was resumed in March, 1891, and in progress at the end of the year.

The Manistee River flows through the city with a rapid current and a narrow channel, with naked banks, and partly obstructed with wharves, booms, etc.

July 1, 1890, balance unexpended		$4,532.14
Amount appropriated by act approved September 19, 1890		50,000.00
		54,532.14
June 30, 1891, amount expended during fiscal year		19,441.20
July 1, 1891, balance unexpended		35,090.94
July 1, 1891, outstanding liabilities	$185.00	
July 1, 1891, amount covered by uncompleted contracts	23,772.00	
		23,957.00
July 1, 1891, balance available		11,133.94
Amount (estimated) required for completion of existing project		75,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		*100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix N N 5.)

6. *Ludington Harbor, Michigan.*—The natural outlet from Pere Marquette Lake had a narrow channel not exceeding 7 feet in depth.

The project of 1867 was to furnish a 12-foot channel between piers 200 feet apart; that of 1885 was to convert it into a harbor of refuge for general commerce by widening the entrance to 400 feet and deepening it to 18 feet.

The revised project of 1890, modified this by omitting the widening while retaining the increased depth, which in any case must be maintained by dredging.

The construction of the piers to their full length was completed in November, 1890. The north pier has a total length of 1,450 feet and projects beyond the shore line 1,030 feet. The south pier has a total length of 2,300 feet and projects into the lake 1,520 feet, overlapping the north pier 350 feet. The entrance width is 250 feet.

The entrance was deepened in July, 1890, and in June, 1891, the dredge again began work to deepen the channel to 18 feet with a width of 70 feet.

The expenditure to July 1, 1890, was $285,736.21, and for the fiscal year $57,235.62.

The sum of $10,000 will be needed for dredging and general minor repairs during fiscal year ending June 30, 1893.

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* The amount includes $15,000 for rebuilding 1,300 linear feet of north revetment; $5,000 for repairing 500 feet of north pier, and $4,000 for dredging.

July 1, 1890, balance unexpended	$66,830.79
June 30, 1891, amount expended during fiscal year	57,235.62
July 1, 1891, balance unexpended	9,595.17
July 1, 1891, outstanding liabilities	362.60
July 1, 1891, balance available	9,232.57
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	10,000.00

(See Appendix N N 6.)

7. *Pentwater Harbor, Michigan.*—The original channel into Pentwater Lake, as constructed at local expense with slab piers, had a width of 75 feet and a depth of 4 feet.

The project of 1866, amended in 1873 and 1884, increased the width to 150 feet and the depth to 12 feet. The works are still incomplete.

The expenditure to July 1, 1890, was $222,952.83, and for the fiscal year $3,375.39.

The harbor was dredged in June and July, 1890, and repairs made to the piers and revetments May to August, 1890.

In May, 1891, the survey showed that a shoal with but 9 feet upon it existed 150 feet in front of the south pier. The piers should be extended to the 15-foot contour.

July 1, 1890, balance unexpended		$3,193.58
Amount appropriated by act appproved September 19, 1890		8,000.00
		11,193.58
June 30, 1891, amount expended during fiscal year		3,375.39
July 1, 1891, balance unexpended		7,818.19
July 1, 1891, outstanding liabilities	$396.00	
July 1, 1891, amount covered by uncompleted contracts	2,832.19	
		3,228.19
July 1, 1891, balance available		4,590.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		*40,000.00

(See Appendix N N 7.)

8. *White River Harbor, Michigan.*—The original outlet from White Lake was improved by local interests to 5 feet. The project of 1866, amended in 1873 and 1884, was to secure a 12-foot navigation between piers 200 feet apart.

The expenditure to July 1, 1890, was $252,485.57.

The works are not yet complete, and opposite the end of the south pier there is a bar with not more than 9 feet.

The expenditure for the fiscal year was $4.375.14.

The entrance was dredged in June and July, 1890, and repairs made August to October, 1890.

July 1, 1890, balance unexpended		$5,493.08
Amount appropriated by act approved September 19, 1890		17,000.00
		22,493.08
June 30, 1891, amount expended during fiscal year		4,375.14
July 1, 1891, balance unexpended		18,117.94
July 1, 1891, outstanding liabilities	$156.00	
July 1, 1891, amount covered by uncompleted contracts	5,345.00	
		5,501.00
July 1, 1891, balance available		12,616.94

* This amount includes $18,000 required for repairs of existing works, and for dredging.

Amount (estimated) required for completion of existing project	$18,225.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	40,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 8.)

9. *Muskegon Harbor, Michigan.*—The entrance to Muskegon River, discharging through Muskegon Lake, had deepened by slab piers with not over 7 feet on the bar in front.

The project of 1866, amended in 1869, 1873, 1881, and 1884, widened the entrance to 300 feet and deepened the navigation to 13 feet. The revised project of 1890 was to close the gap through the north pier. The expenditures to July 4, 1890, were $272,251.23.

The works are not yet complete, but the navigation, with occasional assistance from the dredge, is fairly maintained.

The channel should be deepened to 15 feet and carried through to Muskegon Lake.

The expenditure for the fiscal year was $13,496.34.

The entrance was dredged June and July, 1890, making a channel 125 feet wide and 16 feet deep across the bar, and 75 feet wide by 15 feet between the piers. The south pier was repaired June, July, and August, 1890.

Work began in April, 1891, on the removal of a portion of the old north pier and the building of the new work to connect with the inner end of the outer north pier, and a beginning was made in June on the rebuilding of the outer north crib. The north pier should be extended by four cribs.

July 1, 1890, balance unexpended		$8,209.30
Repayments		14.83
Amount appropriated by act approved September 19, 1890		50,000.00
		58,224.13
June 30, 1891, amount expended during fiscal year		13,496.34
July 1, 1891, balance unexpended		44,727.79
July 1, 1891, outstanding liabilities	$160.00	
July 1, 1891, amount covered by uncompleted contracts	30,015.00	
		30,175.00
July 1, 1891, balance available		14,552.79
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix N N 9.)

10. *Grand Haven Harbor, Michigan.*—Grand Haven, in addition to its local commerce, is the principal harbor of refuge on the east coast of Lake Michigan. Originally improved by the construction of a pier on the south side in connection with the steamers operated by the Detroit, Grand Haven, and Milwaukee Railway terminating at that point, the work was taken in hand by the United States in 1866, with extensions projected in 1880 and 1890, with the object of creating an entrance width of 400 feet and a depth of 18 feet in the interest of general commerce. The work has been attended with very beneficial results, but the constant encroachment of sand from the huge dunes lying between the lake and the bend of the stream and which the current transported to the entrance, has in connection with wave action in the lake maintained a bar at the entrance just beyond the ends of the piers, which at times becomes dangerous.

The expenditures to July 1, 1890, were $546,853.91. Much remains to be done to put the work in satisfactory condition. The piers should be extended to their full length, and the moving sands of the north bank must be controlled.

The expenditure for the fiscal year was $19,232.46, covering dredging, general, and minor repairs, and part payment on account of dredging plant, of which it was proper and needful that Grand Haven should pay its proportion.

In addition, contracts were made for procurement of material for repair and construction by day labor and for the construction of 6 cribs, 3 on each pier, to extend them 150 feet. Work began on the pier construction May 11, 1891, and at the close of the fiscal year was well under way.

The estimate of $125,000 for 1893 will complete the pier and revetment work and provide for needed reconstruction and repair.

July 1, 1890, balance unexpended		$2,654.64
Amount appropriated by act approved September 19, 1890		75,000.00
		77,654.64
June 30, 1891, amount expended during fiscal year		19,232.46
July 1, 1891, balance unexpended		58,422.18
July 1, 1891, outstanding liabilities	$377.73	
July 1, 1891, amount covered by uncompleted contracts	34,427.00	
		34,804.73
July 1, 1891, balance available		23,617.45
Amount (estimated) required for completion of existing project		125,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		125,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 10.)

11. *Holland [Black Lake] Harbor, Michigan.*—The original outlet from Black Lake was opened at local cost to a depth of 5 feet, and the project of 1866, amended in 1873, 1879, and 1884, was to provide a 12-foot navigation between piers 200 feet apart.

The expenditures to July 1, 1890, were $264,588.10, but the inadequacy of appropriation for late years has permitted the entrance to be choked with sand.

The project should be revised to extend the piers and deepen the navigation to 14 feet. A new translake line has been established connecting with Milwaukee, and the harbor has acquired greater importance.

The expenditures for the fiscal year 1891 were $8,199.59.

In April, 1890, the entrance had shoaled to 8 feet and was dredged April 12 to May 1, and May 20 to June 16, making a channel 50 feet wide and 14 feet deep.

July 1, 1890, balance unexpended		$27.21
Amount appropriated by act approved September 19, 1890		10,000.00
		10,027.21
June 30, 1891, amount expended during fiscal year		3,199.59
July 1, 1891, balance unexpended		6,827.62
July 1, 1891, outstanding liabilities	$614.22	
July 1, 1891, amount covered by uncompleted contracts	1,850.00	
		2,464.22
July 1, 1891, balance available		4,363.40

Amount that can be profitably expended in fiscal year ending June 30, 1893 $45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 11.)

12. *Saugatuck Harbor, Michigan.*—The harbor is at the mouth of the Kalamazoo River. The stream is of considerable natural capacity, with 6 to 8 feet of depth, and the project of 1867, modified in 1869, 1870, 1875, and 1882, was to construct a 12-foot navigation, with entrance piers and extensive shore revetments on the river banks. The main difficulty has been the shifting sands bordering the river on the north side, and these have never been effectually controlled. The works were never completed, and are now in part in a ruinous condition, no appropriation for construction having been made since 1886. The entrance is still frequented and the navigation kept alive by occasional dredging.

The expenditures to July 1, 1890, were $140,256.83, and for the fiscal year $641.24 for dredging.

July 1, 1890, balance unexpended		$182.17
Amount received from sale of materials to Manistee Harbor, 1891		1,917.37
		2,099.54
June 30, 1891, amount expended during fiscal year		641.24
July 1, 1891, balance unexpended		1,458.30

Amount (estimated) required for completion of existing project 35,260.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 12.)

13. *South Haven Harbor, Michigan.*—The original improvement of the entrance was at local expense to a width of 85 feet and depth of 6 or 7 feet. The project of 1866, revised in 1869 and 1872, was for 12-foot depth between piers 180 feet apart.

The act of August 11, 1888, extended the harbor to the highway bridge one-half mile above the inner ends of the piers.

The expenditure to July 1, 1890, was $191,619.74. The works are not yet complete, but with dredging the navigation is partly maintained.

In order to reach the 15-foot contour in the lake, which is necessary to maintain 12 feet, the piers must be extended.

The expenditure for the fiscal year was $3,506.32.

At the opening of navigation in 1891 the entrance depth was 10 feet, and dredging is now in progress, as also repairs to the north pier.

July 1, 1890, balance unexpended		$405.26
Amount appropriated by act approved September 19, 1890		15,000.00
		15,405.26
June 30, 1891, amount expended during fiscal year		3,506.32
July 1, 1891, balance unexpended		11,898.94
July 1, 1891, outstanding liabilities	$1,163.79	
July 1, 1891, amount covered by uncompleted contracts	2,861.21	
		4,025.00
July 1, 1891, balance available		7,873.94

Amount (estimated) required for completion of existing project.....	$50,426.80
Amount that can be profitably expended in fiscal year ending June 30, 1893	45,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix N N 13.)

14. *St. Joseph Harbor, Michigan.*—Prior to improvement the channel was a shifting one, 3 to 7 feet deep. The locality was selected as long ago as 1836 as a harbor of refuge for lake commerce and the improvement has since gone on, the project providing for 16 feet depth between piers about 250 feet apart. In 1880 the regulation was extended to include the deepening of the canal, built under State authority, to connect the upper end of the St. Joseph Harbor with Benton Harbor.

Since 1870, when the Chicago and West Michigan Railway built a trestle and drawbridge near the entrance, the harbor has practically ceased to be a harbor of refuge, but the local commerce continued to develop.

In consequence of objections having been made to the Secretary of War that this bridge obstructed navigation the local engineer was directed to make a full investigation, by public hearing, and the results were reported under date of August 22, 1890.

The total expenditure to July 1, 1890, was $354,058.05.

Extensions have been made from time to time, particularly to the north pier, as the sand accumulations against it formed bars at the entrance. The depth has varied from 13 to 15 feet at the mouth, with 11 and 12 feet inside the harbor and through the canal. A considerable extension of the entrance pier is now needful, as shoals have formed in the lake well outside the harbor.

For the fiscal year the expenditure was $8,952.31. Repairs were made to the north pier October to December, 1890, and continued in May and June, 1891.

Dredging, begun April 11, 1891, is still in progress, deepening the canal to 14 feet and removing sand accumulations between the piers.

July 1, 1890, balance unexpended.....		$54.95
Amount appropriated by act approved September 19, 1890		20,000.00
		20,054.95
June 30, 1891, amount expended during fiscal year		8,952.31
July 1, 1891, balance unexpended.....		11,102.64
July 1, 1891, outstanding liabilities.....	$1,525.00	
July 1, 1891, amount covered by uncompleted contracts	2,238.00	
		3,763.00
July 1, 1891, balance available		7,339.64
Amount that can be profitably expended in fiscal year ending June 30, 1893		30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix N N 14.)

15. *St. Joseph River, Michigan.*—The distance covered by the navigation is 25 miles from St. Joseph to Berrien Springs, and under the project of March, 1889, the improvement has been made by removal of snags and bowlders, and the construction of small wing dams at several points to concentrate the channel with the object of securing 3 or 4 feet at low water.

The expenditure to July 1, 1890, was $1,343, and for the fiscal year $1,153.82.

The results have proved satisfactory to the steamer engaged in the

traffic, and with the balance in hand the work will be continued this season.

July 1, 1890, balance unexpended	$1,157.00
Amount appropriated by act approved September 19, 1890	1,000.00
	2,157.00
June 30, 1891, amount expended during fiscal year	1,153.82
July 1, 1891, balance unexpended	1,003.18

(See Appendix N N 15.)

16. *Michigan City Harbor, Indiana.*—The works at this harbor consist of the improvement of Trail Creek by entrance piers 100 feet apart and dredging the creek bed to 13 feet, the local authorities and owners attending to the bank revetting, constituting the "inner harbor," and of extensive breakwater and pier constructions in the open lake constituting the "outer harbor." The actual harbor at Michigan City is the creek, the outer basin not being susceptible of use by reason of exposure to heavy winds from the northwest, driving seas through a 400-foot gap in the outer breakwater.

Outer harbor.—The project of 1870 for the construction of the outer basin and that of 1883 for the exterior breakwater designed a harbor of refuge, but the basin is not available for the purpose and the breakwater is only just begun. It is designed to have a total length of 2,000 feet, of which 500 feet have been built and await the superstructures on the crib.

The total expenditure for the outer works to July 1, 1890, was $648,707.88, and for the fiscal year 1890 $28,440.38.

The three outer cribs of the breakwater pier, an offshore spur or projection of the north breakwater, adjacent to the gap, and the leveling up of the two older connecting cribs, were completed May to October, 1890, and repairs were made to the west pier stopping gaps and renewing filling and decking.

May 10, 1891, work began upon the superstructure of the ten cribs in the exterior breakwater, leveling them up and framing timber.

July 1, 1890, balance unexpended		$21,252.89
Repayments		142.37
Amount appropriated by act approved September 19, 1890		50,000.00
		71,395.26
June 30, 1891, amount expended during fiscal year		28,440.38
July 1, 1891, balance unexpended		42,954.88
July 1, 1891, outstanding liabilities	$846.76	
July 1, 1891, amount covered by uncompleted contracts	8,100.00	
		8,946.76
July 1, 1891, balance available		34,008.12
Amount (estimated) required for completion of existing project		279,613.50
Amount that can be profitably expended in fiscal year ending June 30, 1893		90,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Inner harbor.—The total expenditure to July 1, 1890, was $101,682.49. No work was done during the past year, the expenditure of $850 being for proportionate allotment for general contingencies.

July 1, 1890, balance unexpended	$192.51
Amount appropriated by act approved September 19, 1890	7,500.00
	7,692.51
June 30, 1891, amount expended during fiscal year	850.00
July 1, 1891, balance unexpended	6,842.51
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix N N 16.)

EXAMINATION AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Grand River, Michigan, below Grand Rapids, with a view of determining the existence or nonexistence of underlying rock, the hydraulics of the river and the detailed topography of the valley subject to overflow*, was made by the local engineer in charge, Major Ludlow, and report thereon submitted through Col. O. M. Poe, Corps of Engineers, Division Engineer, Northwest Division. It is the opinion of Major Ludlow, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Major Ludlow was charged with its survey, the report on which will be submitted when received.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN EASTERN MICHIGAN.

Officer in charge, Col. O. M. Poe, Corps of Engineers, having under his immediate orders Lieut. Charles S. Riché, Corps of Engineers, the entire year, and Lieut. Harry F. Hodges, Corps of Engineers, to August 18, 1890.

1. *St. Marys River, Michigan.*—The project for obtaining a navigable channel of 16 feet depth between Lakes Superior and Huron had been barely completed when the demands of commerce so enormously increased, that the work of obaining a depth of 20 feet throughout was undertaken with the full sanction of both legislative and executive authority.

A necessary part of the project is the construction of a new lock upon the site of the old State locks, to have a length of 800 feet between gates, a width of 100 feet throughout, a depth of 21 feet on the miter sills, and a single lift approximating 18 feet. The canal is to be deepened to correspond. The estimated cost of this enlargement of the canal system is $4,738,865, for the details of which see pages 2220 *et seq.* of the Annual Report of the Chief of Engineers for 1887.

The cofferdam surrounding the site of the new lock pit is completed, the pier in front of Fort Brady is completed, and nearly all the necessary material has been filled in behind it. The excavation of the lock pit is nearly finished, and work on the construction of the masonry has been begun.

In view of the importance of losing no time in the prosecution of the work an estimate of $2,000,000 is submitted, as the conditions now existing require that this amount should be available in addition to that

already on hand. This entire amount can be expended to advantage during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1890		$339,026.06
Expended during fiscal year		188,650.68
Total expenditure to June 30, 1891		587,676.74
July 1, 1890, balance unexpended		859,414.41
Amount appropriated by act approved September 19, 1890		900,000.00
Amount appropriated by sundry civil act approved March 3, 1891		600,000.00
		2,359,414.41
June 30, 1891, amount expended during fiscal year		172,078.97
July 1, 1891, balance unexpended		2,187,335.44
July 1, 1891, outstanding liabilities	$24,985.55	
July 1, 1891, amount covered by uncompleted contracts	1,293,168.47	
		1,318,154.02
July 1, 1891, balance available		869,181.42
Amount (estimated) required for completion of existing project		2,238,865.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		2,000,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O O 1.)

2. *Operating and care of St. Marys Falls Canal, Michigan.*—During the fiscal year the canal was open to navigation 221 days. It was closed for the winter December 3, 1890, and opened April 27 for the season of 1891.

Nine thousand five hundred and forty-one vessels, etc., aggregating 7,431,423 registered tons, and carrying 8,338,981 tons of freight and 26,226 passengers, passed through the canal in 4,614 lockages.

The staple articles transported were 2,298,487 tons of coal, 48,816 tons of copper, 3,460,238 barrels of flour, 19,476,073 bushels of grain, 3,873,044 tons of iron ore, 108,441 tons of pig and manufactured iron, 188,272 barrels of salt, 3,076 tons of silver ore, 383,461,000 feet B. M. of lumber, 45,506 tons of building stone, 2,408 tons of wool, 937 tons of hides, and 351,030 tons of miscellaneous or unclassified freight.

The expenditures on account of operating and care for the fiscal year aggregated $45,417.66. The estimated amount required for the fiscal year ending June 30, 1891, is $67,400, all of which is already provided for by indefinite appropriation.

Total expenditure to June 30, 1890		$270,597.68
Expended during fiscal year		45,417.66
Total expenditure to June 30, 1891		316,015.34
Amount required for fiscal year ending June 30, 1892		67,400.00
Balance remaining for allotments of preceding year, exclusive of outstanding liabilities	$23,039.21	
Outstanding liabilities	3,370.10	
		19,669.11
Additional allotment required for fiscal year ending June 30, 1892		47,730.89

(See Appendix O O 2.)

3. *Dry dock at St. Marys Falls Canal, Michigan.*—The proposition to locate a dry dock in immediate proximity to the lockage system is as objectionable as ever; but if it should be decided to do so, then the location heretofore referred to, at the eastern end of the area transferred

from the Fort Brady military reservation to the canal reservation is the least objectionable.

But the construction of a pier in front of the Fort Brady reservation has been completed and a portion of this work would have to be removed, thus increasing by $20,000 the probable cost of a dry dock, and the estimate therefor should be increased accordingly.

Amount (estimated) required for the construction of a dry dock at the point indicated, $343,872.

It is understood that the State of Michigan holds $65,000 in readiness to transfer to the United States for the purpose of constructing a dry dock at St. Marys Falls Canal.

(See Appendix O O 3.)

4. *Hay Lake Channel, St. Marys River, Michigan.*—Before improvements were commenced the channel through Hay Lake was restricted in depth at Sugar Island Rapids and at the Middle Neebish; at these two places a maximum draft of but 8 or 9 feet could be carried if a very irregular course was taken, and practically vessels drawing more than 6 feet of water would not attempt the passage. In addition to the places above mentioned there were some shoals in Hay Lake requiring removal to make the channel available for the vessels navigating St. Marys River.

The original estimates for this improvement were based upon a project for a channel 300 feet wide and 17 feet deep, leaving the present navigable channel of St. Marys River at Sugar Island Rapids (about 2½ miles below the canal), through those into Hay Lake, and then, by way of the Middle Neebish, rejoining the present navigable channel at the foot of Sugar Island, thus saving a distance of 11 miles and obtaining a route which can be so marked by lights as to be navigable at night—a condition impracticable with the present channel except by the use of many lights.

The estimated cost of this project was $2,127,292. The project was subsequently modified to increase the navigable depth to 20 feet, the estimated cost being $2,659,115, subject to change, however, in case unexpected difficulties are developed during the progress of the work.

The contract of Messrs. C. F. and H. T. Dunbar, dated October 30, 1888, was completed in November, 1890, 65,117 cubic yards, bank measure, having been excavated since May 31, 1890, and a total of 151,916 cubic yards above 20 feet grade and 19,225 cubic yards between 20 and 21 feet grades having been excavated under this contract.

The river and harbor act of September 19, 1890, permitted contracts to be made for all or any portion of the work. Accordingly all the excavation remaining to be done was contracted for on February 6, 1891. The channel was divided into six sections, and a separate contract made for each section. By May 31, 1891, a total of 20,958 cubic yards, bank measure, had been excavated under these contracts, and work was still in progress.

The estimate for the work is $2,659,115, of which $1,675,000 has been appropriated, leaving $984,115 to be provided for. To pay the various Government employés and contractors $500,000 will be required for the fiscal year ending June 30, 1893. This amount should be appropriated with the proviso that any portion of it not required for the Hay Lake Channel could be expended elsewhere between Lake Superior and Huron at places where excavation is needed to attain the navigable depth of 20 feet. This entire amount can be expended to advantage during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1890		$657,315.88
Expended during fiscal year		171,507.20
Total expenditure to June 30, 1891		828,823.08
July 1, 1890, balance unexpended		334,066.70
Amount appropriated by act approved September 19, 1890		400,000.00
Amount appropriated by sundry civil act approved March 3, 1891		300,000.00
		1,034,066.70
June 30, 1891, amount expended during fiscal year		184,370.90
July 1, 1891, balance unexpended		849,695.80
July 1, 1891, outstanding liabilities	3,387.23	
July 1, 1891, amount covered by uncompleted contracts	843,460.35	
		846,847.58
July 1, 1891, balance available		2,847.22
Amount (estimated) required for completion of existing project		984,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix O O 4.)

5. *Harbor at Cheboygan, Michigan.*—Prior to undertaking any improvement at this harbor, only 6½ to 7 feet of water could be carried across the bar at the mouth of Cheboygan River.

The original project for the improvement, adopted in 1871, contemplated dredging a channel 200 feet wide and 14 feet deep through the bar, and revetting each side by a pile pier. Experience gained during the progress of the work already done leads to the belief that the piers can be omitted with consequent reduction of cost to the extent of about one-half the original estimate.

Subsequent modifications of the project were made until, as it finally stood, it provided for a channel of 15 feet in depth, and generally 200 feet in width from the 15-foot curve in the Straits of Mackinac to the State Road Bridge.

This has been completed, and until the dredged channel begins to silt up, or the revetting piers contemplated in the original project of 1871 are shown to be necessary, no further work is proposed, and therefore no further estimate is submitted at this time.

Total expenditure to June 30, 1890		$129,648.33
Expended during fiscal year		57.70
Total expenditure to June 30, 1891		129,706.03
July 1, 1890, balance unexpended		18,385.43
June 30, 1891, amount expended during fiscal year		45.00
July 1, 1891, balance unexpended		18,340.43
July 1, 1891, outstanding liabilities		12.70
July 1, 1891, balance available		18,327.73

(See Appendix O O 5.)

6. *Harbor at Thunder Bay, Michigan.*—Prior to the commencement of improvements there was a navigable channel from Thunder Bay into the river of 12 feet depth, and of a variable width, which at one place was only 50 feet. The original project for the improvement of the harbor was adopted in 1876 and provided for an entrance channel from the bay into the river of navigable width, and of not less than 13 feet depth, a subsequent modification increasing the proposed depth to 14 feet.

The work was practically completed in 1884, but it was then stated

that the improvement was of such a character that it would require attention from time to time, and it was recommended that a sufficient appropriation be made to render $10,000 available for use when it should be wanted.

On June 30, 1890, a channel 80 feet wide and 14 feet deep extended across the bar at the mouth of the river, and a clear depth of 13 feet was available from there to the Second Street Swing Bridge in Alpena, a distance of about 1,800 feet. It was estimated that a full restoration of the 14-foot channel would cost $5,500 and that an appropriation of $30,000 would make the depth 16 feet, this latter depth being the one recommended.

The river and harbor act of September 19, 1890, appropriated $5,500 for "Improving harbor at Thunder Bay, Michigan: To restore fourteen-foot channel," at the same time appropriating $10,000 for "Improving Thunder Bay River, Alpena, Michigan; For sixteen-foot channel from mouth to one mile above." The wording of the act therefore required the depth of 16 feet to be made in the river where vessels drawing more than 14 feet of water could not get, and prevented a greater depth than 14 feet from being made in the harbor in order that the greater depth made in the river might be rendered available.

The language of the act being mandatory, however, a contract for dredging the harbor to the depth of 14 feet was entered into with the Bay City Dredging Company on April 9, 1891, the dredging in Thunder Bay River being done under the same contract, and but one dredge being required for both works; 6,871 yards, scow measure, were removed from the harbor during the fiscal year, and work is still in progress. By June 30, 1891, a channel about 150 feet wide and 14 feet deep extended across the bar.

In view of the fact that the river above the bar is being dredged to a depth of 16 feet, and in view of the commercial importance of the city of Alpena, which is situated at the mouth of the river, the river and harbor are well worth the additional appropriation of $20,587.48, which, if made at one time, and rendered available for both river and harbor, will probably suffice to increase their depth to 16 feet. This entire amount can be profitably expended during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1890		$18,888.70
Expended during fiscal year		1,897.11
Total expenditure to June 30, 1891		20,785.81
July 1, 1890, balance unexpended		59.79
Amount appropriated by act approved September 19, 1890		5,500.00
		5,559.79
June 30, 1891, amount expended during fiscal year		187.29
July 1, 1891, balance unexpended		5,372.50
July 1, 1891, outstanding liabilities	$1,145.18	
July 1, 1891, amount covered by uncompleted contracts	4,227.32	
		5,372.50
Amount (estimated) required for completion of combined projects for Thunder Bay River and Harbor, Michigan		20,587.48
Amount that can be profitably expended in fiscal year ending June 30, 1893		20,587.48

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O O 6.)

7. *Thunder Bay River, Michigan.*—Before improvements were commenced Thunder Bay River, from its mouth to one mile above, varied in width from 175 to 100 feet, and had a navigable channel of from 14 to 11 feet deep, except at the upper end, where the depth diminished to 5 feet.

On April 17, 1889, as a result of a survey made in compliance with the river and harbor act of August 11, 1888, an estimate of $36,087.48 was made for improving the river to a depth of 16 feet within the dock lines established by the city engineer of Alpena in 1888 from the 16-foot curve in Thunder Bay to 1 mile above the mouth of the river.

The river and harbor act of September 19, 1890, appropriated $10,000 for "Improving Thunder Bay River, Alpena, Michigan: For sixteen-foot channel from mouth to one mile above," at the same time appropriating $5,500 for "improving harbor at Thunder Bay, Michigan: To restore fourteen-foot channel." The wording of the act was such, therefore, as to prevent the application of any part of the $10,000 to the bar between the mouth of the river and the 16-foot curve in the bay, and the $5,500 appropriated for this latter locality was for part of the work included in the estimate of $36,087.48 made in 1889. Moreover, the depth of 16 feet was required in the river where vessels drawing more than 14 feet of water could not get and the depth in the harbor was restricted to 14 feet, thereby preventing the greater depth in the river from being rendered available.

The language of the act being mandatory, however, a contract for dredging the river to the depth of 16 feet was entered into with the Bay City Dredging Company on April 9, 1891, the dredging in Thunder Bay Harbor being done under the same contract, and but one dredge being required for both works. Seven thousand four hundred and twenty-one cubic yards, scow measure, were removed from the river during the fiscal year, and work is still in progress. By June 30, 1891, one dredge cut, about 25 feet wide and 16 feet deep, extended upon the northerly side of the axis of the river from the light-house crib at the mouth to the Second Street Swing Bridge in Alpena, and a second dredge cut had been made upon the southerly side of the axis for about half this distance.

In view of the commercial importance of the city of Alpena, which is situated at the mouth of the river, the river and harbor are well worth the additional appropriation of $20,587.48, which, if made at one time and rendered available for both river and harbor, will probably suffice to increase their depth to 16 feet. This entire amount can be profitably expended during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1891		$1,724.10
Amount appropriated by act approved September 19, 1890		10,000.00
June 30, 1891, amount expended during fiscal year		391.50
July 1, 1891, balance unexpended		9,608.50
July 1, 1891, ontstanding liabilities	$1,332.60	
July 1, 1891, amount covered by uncompleted contracts	8,275.90	
		9,608.50

NOTE.—The estimate of the amount required for completion of the combined projects for improving Thunder Bay River and Harbor, with the estimate of the amount that can be profitably expended in fiscal year ending June 30, 1893, is given in the money statement for Thunder Bay Harbor, Michigan, page 349.

(See Appendix O O 7.)

8. *Harbor at Au Sable, Michigan.*—Before the beginning of improvements the mouth of Au Sable River was 150 feet wide, with a depth of 5 feet over the bar. Above the mouth for a quarter of a mile 7 to 10 feet of water was found, and above this point only 5 or 6 feet.

The present project for the improvement of the harbor was adopted in 1866 and modified in 1879, the object being to obtain a channel of not less than 10 feet in depth for a width of 100 feet from Lake Huron to the State Road Bridge at Au Sable.

The money heretofore expended on this improvement has given temporary results only, and a permanent channel can not be secured except at so great a cost as to be disproportionate to the benefits to be obtained. No further estimate is therefore submitted.

Total expenditure to June 30, 1890	$113,782.07
Expended during fiscal year	4.05
Total expenditure to June 30, 1891	113,786.12
July 1, 1890, balance unexpended	200.55
July 1, 1891, balance unexpended	200.55
July 1, 1891, outstanding liabilities	4.05
July 1 1891, balance available	196.50

(See Appendix O O 8.)

9. *Saginaw River, Michigan.*—Before the improvements were begun the entrance to Saginaw River was obstructed by a bar in Saginaw Bay about a mile from the shore and a half mile in width between the 10-foot curves, with a minimum depth of about 9 feet. Between the mouth of the river and Bay City, a distance of about 5 miles, the depth varied from 15 to 30 feet. Thence to the head of the river, a further distance of about 16 miles, the channel was obstructed by a number of bars having only 7 feet of water upon them, thus limiting the navigable depth to about 7 feet, although the prevailing depth varied between 12 and 20 feet.

The original project for the improvement of the river was adopted in 1866. Various additions were subsequently made to it until 1882, when a Board of Engineers recommended that a channel be made 200 feet wide with a depth of 14 feet from Saginaw Bay to Bay City, and with a depth of 12 feet thence to the head of the river, a total distance of about 23 miles.

Additions to this project have been made at various times. These provided for the repair, extension, and reconstruction of the revetment confining the Carrollton Channel, and for the construction of similar works at the head of Crow Island for the improvement of Zilwaukie Bar.

On June 30, 1890, the Carrollton revetment and the plank-beam training-wall opposite to it were completed. A maximum draft of 12 feet could be carried entirely across the bar at the mouth of the river, although the greater portion of its crest had been dredged to a depth of 14 feet, and from Bay City to Saginaw navigation was limited to a depth of 9 or 10 feet by various shoals, although the average depth was much greater.

The river and harbor act of September 19, 1890, appropriated $75,000 for continuing the improvement, with the proviso that half of this amount should be expended above Bay City. During the winter ice surveys

were made at various localities, and by June 30, 1891, the following progress had been made on the different works:

Bar at mouth of river.—Under contract with Messrs. McCollum and Lee, dated April 9, 1891, 9,222 cubic yards, scow measure, was removed from the fourth cut west of the axis of the proposed channel across the bar, and work was still in progress at the close of the fiscal year.

West Channel, along West Bay City.—As no specific appropriation was made for this locality, and as it is not included in the general project for the improvement of the river, no work was done here during the fiscal year.

Above Bay City.—The Carrollton revetment, completed last year, suffered severely from a general conflagration that occurred in the vicinity in July, 1890, and about $6,000 of the appropriation of $37,000 made for this part of the river is being applied to its repair. An extension is being made to Crow Island wing dam, and dredging is in progress. All materials are purchased and all dredging is done under contract, the repairs being done by hired labor. At the close of the fiscal year 31,344 feet B. M. pine timber, 29,504 feet B. M. pine plank, 52,160 feet B. M. hemlock plank, and 7,163 pounds wrought-iron tie rods had been furnished; 12,412 linear feet Norway pine piles had been furnished and driven, 893 linear feet of the Carrollton revetment had been repaired, 150 feet more being in various stages of progress, and 7,123 cubic yards, scow measure, had been removed from the east side of the channel at the head of Crow Island.

The $6,000 estimated for repairing the burnt portion of the Carrollton revetment is not chargeable to the general project for improving the river. Of the $75,000 appropriated, therefore, only $69,000 will be applied to that project. The improvement of the West Channel along West Bay City also forms no part of the general project and its cost is not chargeable thereto. It is not expected that the channel depth can be maintained without some dredging nearly every year. The amount of this will be affected as the projected structures approach completion, but they can not entirely obviate it, and, notwithstanding the temporary character of the benefits obtained by dredging, it should be continued from year to year, as giving relief to an annual commerce of about 2,000,000 tons, having a value of about $20,000,000.

The estimated amount required for the completion of the general project, including $10,000 for completing improvement of West Channel along West Bay City, is $168,250, and this entire amount can be profitably expended during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1890		$488,732.43
Expended during fiscal year		14,599.35
Total expenditure to June 30, 1891		503,331.78
July 1, 1890, balance unexpended		4,543.04
Amount appropriated by act approved September 19, 1890		75,000.00
		79,543.04
June 30, 1891, amount expended during fiscal year		5,815.62
July 1, 1891, balance unexpended		73,727.42
July 1, 1891, outstanding liabilities	$8,783.73	
July 1, 1891, amount covered by uncompleted contracts	64,943.69	
		73,727.42

Amount (estimated) required for completion of existing project	$168,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	168,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 9.)

10. *Harbor of refuge at Sand Beach, Lake Huron, Michigan.*—Prior to 1876 vessels, when caught in heavy weather near the dangerous Pointe aux Barques, the southerly headland of the mouth of Saginaw Bay, were compelled to run a distance of 60 miles and find refuge in St. Clair River. After the subsidence of the storm those upward bound had to work their way back again.

The project for the construction of a harbor of refuge at Sand Beach was adopted in 1873, and consisted of a breakwater, constructed of timber cribs filled with stone, inclosing an area which is to be deepened by dredging where necessary.

The estimate of the probable cost of the improvement was $1,442,500. The sum of $1,155,000 has been appropriated for the work, and it was practically completed in 1885, at a cost of about $975,000. Few improvements have resulted in greater benefit to the lake commerce, as is fully shown by the infrequency of disasters in the vicinity since it became available.

During the fiscal year ending June 30, 1891, the Government boats were kept in order and repairs were made to the piers where they had been injured by storms, work on the pier foundations being done by a diver. Under contract with Mr. Henry N. Loud, dated June 23, 1890, 106,755 feet, B. M., of white pine timber and plank was delivered and the contract was closed, and 8,067 feet, B. M., of white oak plank was purchased from Mr. Adolphus Granger. The survey of the harbor was completed, and, under contract with Mr. Chauncey E. Mitchell, dated June 16, 1890, for hire of dredge and outfit by the hour, 6,164 cubic yards, scow measure, of hard clay, bowlders, and sandstone bed rock was removed during $560\frac{5}{6}$ hours' work, and it is expected that dredging will be resumed by the contractor early in July, 1891.

The superstructure of the piers, especially that of the west pier, is in a bad condition, and while the frequent repairs and renewals of timber and plank give the whole an appearance of strength and solidity, age and decay have partially or wholly destroyed many interior timbers, which can not be removed without tearing down the entire superstructure, and which are not even discovered until a severe storm lays them open for inspection.

There is no doubt, therefore, that the present timber superstructure will continue to suffer more and more each succeeding year, and that the annual cost of its repair will steadily increase. For this reason the next appropriation, if sufficient in amount, should be expended in beginning the construction of a superstructure of concrete or other permanent material; part of the appropriation to be expended for current repairs, for custody and control of the harbor, and for dredging in and about the harbor, and $230,000 can be profitably expended during the fiscal year ending June 30, 1893.

As is well known, this harbor has but little local importance, but it is of incalculable benefit to the general commerce of the lakes. The extent to which it is utilized makes it well worthy the sum asked for its preservation.

One thousand five hundred and twenty-five vessels, with an aggregate of 517,374.83 tons register, entered the harbor for shelter during the fiscal year.

Total expenditure to June 30, 1890		$1,076,223.44
Expended during fiscal year		15,588.82
Total expenditure to June 30, 1891		1,091,812.26
July 1, 1890, balance unexpended		45,246.35
Amount appropriated by act approved September 19, 1890		30,000.00
		75,246.35
June 30, 1891, amount expended during fiscal year		15,572.84
July 1, 1891, balance unexpended		59,673.51
July 1, 1891, outstanding liabilities	$1,255.54	
July 1, 1891, amount covered by uncompleted contracts	10,569.42	
		11,824.96
July 1, 1891, balance available		47,848.55
Amount (estimated) required for current expenses and beginning permanent superstructure		230,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		230,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix O O 10.)

11. *Black River at Port Huron, Michigan.*—Before improvements were commenced the lower reach of Black River from its mouth to the Grand Trunk Railroad Bridge, a length of nearly 1½ miles, varied in width from 120 to 150 feet, and had a navigable channel of from 10 to 14 feet in depth, except at a few points, where it was obstructed by shoals or bars having only 8½ feet of water over them.

On May 9, 1889, as a result of a survey, made in compliance with the river and harbor act of August 11, 1888, an estimate of $55,110 was made for improving the river from its mouth to the Grand Trunk Railroad Bridge to a depth of 15 feet.

The river and harbor act of September 19, 1890, appropriated $25,000 for "Improving Black River at Port Huron, Michigan; to deepen channel from mouth to Grand Trunk Railroad Bridge to a depth of sixteen feet," 1 foot greater depth than that for which the estimate of $55,110 had been made.

A general project for the improvement of the river to the depth named in the appropriation was approved in January, 1891. It contemplates excavating a channel 16 feet deep from the mouth of the river to the Grand Trunk Railroad Bridge, and of width varying between 160 and 75 feet, according to locality. On account of the greater depth, the estimate for the work was increased to $75,000.

Under contract with Mr. Chauncey E. Mitchell, dated March 11, 1891, 18,225 cubic yards, scow measure, has been excavated during the fiscal year, and work is still in progress. On June 30, 1891, a channel 16 feet deep and 75 feet wide extended from the mouth of the river to Military Street Bridge, a distance of about 1,700 feet.

As this river runs through the business portion of Port Huron, the expenditure of this appropriation will prove a great benefit to the various mercantile and manufacturing establishments along its banks, and will also be followed by the utilization of the river as a winter harbor, where vessels may find perfect safety from ice. Dredging should therefore be continued until the present project is completed, and $30,000

can be expended to advantage during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1891		$2,399.11
Amount appropriated by act approved September 19, 1890		25,000.00
June 30, 1891, amount expended during fiscal year		1,168.77
July 1, 1891, balance unexpended		23,831.23
July 1, 1891, outstanding liabilities	$1,230.34	
July 1, 1891, amount covered by uncompleted contracts	22,600.89	
		23,831.23
Amount (estimated) required for completion of existing project		50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O O 11.)

12. *Mouth of Black River, Michigan.*—Black River empties into St. Clair River at Port Huron, Mich. At and below its mouth, extending beyond the middle of St. Clair River, there is a bar or middle ground which was dredged by the Government, under former appropriations, to a clear depth of 15 feet. The main channel of St. Clair River is found between the middle ground and the Canadian shore.

By the deposit of material brought down by the current of Black River, the depth of this bar has been reduced an average of about 6 inches, and in conjunction with a low stage of water has become an impediment to navigation along the front of the city in the vicinity of the mouth of Black River.

The approved project for the improvement of this bar contemplates making a series of dredge cuts of a uniform depth of 16 feet along the dock front of Port Huron, from the 16-foot curve above to the same curve below the mouth of Black River, the first cut at a distance of about 50 feet from the wharves, and the others to continue the work outward as far as the available funds will permit.

On June 30, 1890, a channel of 16 feet clear depth extended from the 16-foot curve above the mouth of the river to the same curve below, and from a line parallel to the wharves and 50 feet outside of them towards the middle of St. Clair River, making the improved channel about 300 feet wide.

The river and harbor act of September 19, 1890, appropriated $10,000 for continuing the improvement, and under contract with the Bay City Dredging Company, dated March 11, 1891, 17,504 cubic yards, scow measure, has been excavated during the fiscal year, and work is still in progress. On June 30, 1891, a channel of 16 feet clear depth extended from the 16-foot curve above the mouth of Black River to the same curve below, and from a line parallel to the wharves and 50 feet outside of them towards the middle of St. Clair River, making the improved channel 550 feet wide, its total length being about 2,200 feet.

The expenditure of this appropriation will afford very marked relief. Not only the local commerce of Port Huron, but the general commerce of the lakes is interested in this improvement, and the work should be continued until a uniform depth of 16 feet is obtained over the whole extent of the bar. Twenty thousand dollars can be expended to advantage during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1890		$9,798.74
Expended during fiscal year		3,069.49
Total expenditure to June 30, 1891		12,868.23
July 1, 1890, balance unexpended		201.26
Amounted appropriated by act approved September 19, 1890		10,000.00
		10,201.26
June 30, 1891, amount expended during fiscal year		941.79
July 1, 1891, balance unexpended		9,259.47
July 1, 1891, outstanding liabilities	$2,127.70	
July 1, 1891, amount covered by uncompleted contracts	7,131.77	
		9,259.47
Amount that can be profitably expended in fiscal year ending June 30, 1893		20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix O O 12.)

13. *St. Clair Flats Canal, Michigan.*—Before the construction of this canal St. Clair River emptied into Lake St. Clair through seven principal mouths or passes, the one ordinarily used by vessels being known as the South Channel and having a minimum depth of a little less than 11 feet.

St. Clair Flats Canal was projected in 1866 with a view to obtaining a straight channel 13 feet deep and 300 feet wide across the flats east of the mouth of the South Channel, and the work was finished in 1871.

The canal is bounded on each side by a dike 7,221 feet long, or an aggregate of 14,442 feet, these dikes consisting of timber resting upon piles driven into the original bottom of the shoal, the crib pockets being filled with material dredged from the channel and the cribs backed with dredged material.

To maintain a channel bank a single row of sheet piling was driven along the channel face of the cribs previous to dredging, and the back or lake sides of the dikes were protected from wave action by shorter sheet piling.

In 1873 the channel was deepened to 16 feet by dredging for a width of 100 feet on each side of the axis of the canal, or a width of 200 feet in all, being thus limited by the fact that the single row of sheet piles, intended for a depth of 13 feet, had not sufficient penetration to admit of dredging to 16 feet for the full width of the canal, and was also insufficient to prevent leakage of the dike filling through it into the channel.

All timber above water in the old structure, having now been in place an average of 23 years, is very badly decayed. This fact and the increasing demands of commerce for a greater depth of water necessitated remedial measures, and a project was approved in 1887, which contemplates driving a double row of sheet piling to a depth of 26 feet along the channel face of each dike, dredging the area between the dikes to a depth of 20 feet, continuing the channel above and below the canal to the same depth in river and lake, and rebuilding the decayed portions of the timber superstructure, the estimated cost being $200,000, exclusive of the cost of dredging, with the proviso that this estimate would have to be modified should the price of materials and labor continue to increase.

In 1889 it was stated that a depth of 18 feet and width of 300 feet would be sufficient until the general project for a continuous depth of 20 feet along the entire water route should have reached a more

advanced stage, and an estimate of $165,000 was made for attaining this depth by dredging.

On June 30, 1890, about three-fourths of the double row of sheet piling had been finished, about 3,600 running feet along the south half of the west dike remaining to be completed, and dredging operations had not been begun, owing to lack of funds.

The river and harbor act of September 19, 1890, appropriated $80,000 for continuing the improvement, and under contract with Messrs. Steiner & Griffin, dated November 28, 1890, 490 running feet of revetment has been completed, and work is still in progress. Under contract with Mr. Luther E. Allen, dated November 28, 1890, 43,496 cubic yards, scow measure, has been excavated, and work is still in progress. On June 30, 1891, a channel 18 feet in clear depth and 150 feet wide extended from the 18-foot curve in St. Clair River, about 900 feet above the canal, down into the canal for a total length of about 3,890 feet, the dredged channel occupying the east half of the northern part of the canal.

The estimate for improving the canal and obtaining a depth of 18 feet is $365,000, of which $168,750 has been appropriated. To obtain a depth of 20 feet would increase the estimate by $148,559.40 making the total estimate for this depth $513,559.40, but the general project for a continuous depth of 20 feet along the entire water route is not yet in a sufficiently advanced stage to warrant making this depth at St. Clair Flats Canal at present.

The depth of 18 feet, however, is urgently demanded. All through commerce between Lakes Ontario and Erie and Detroit River, on the one hand, and Lakes Huron, Michigan, and Superior, on the other, must pass through this canal. This commerce is about the same as that through Detroit River, which, for the season of 1890, consisted of 35,640 vessels having a registered tonnage of 21,684,000. When it is considered that this vast commerce is dependent upon the present channel 200 feet in width at St. Clair Flats, the importance of obtaining a channel 300 feet wide and 18 feet deep at the earliest possible date can readily be understood. The amount necessary for completing the project to attain this depth is $196,250, and this entire amount can be profitably expended during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1890		$691,661.91
Expended during fiscal year		15,354.04
Total expenditure to June 30, 1891		707,015.95
July 1, 1890, balance unexpended		3,984.54
Amount appropriated by act approved September 19, 1890		80,000.00
		83,984.54
June 30, 1891, amount expended during fiscal year		5,003.33
July 1, 1891, balance unexpended		78,981.21
July 1, 1891, outstanding liabilities	$10,350.71	
July 1, 1891, amount covered by uncompleted contracts	64,786.45	
		75,137.16
July 1, 1891, balance available, applicable only to Grosse Pointe Channel		3,844.05
Amount (estimated) required for completion of existing project		196,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		196,250.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix OO 13.)

14. *Operating and care of St. Clair Flats Canal, Michigan.*—The canal is in immediate charge of a custodian, who, without additional compensation, also acts as inspector whenever any work is in progress.

During the fiscal year ending June 30, 1891, the ordinary current expenses of operating and care of the canal, such as salary of custodian, trimming willows, etc., amounted to $1,933.20.

The estimated cost of operating and care of the canal for the fiscal year ending June 30, 1892, is as follows:

Salary of custodian	$1,500.00
Current repairs and contingencies which can neither be foreseen nor estimated for in detail, to include a fair proportion of the expenses of the office of the superintending engineer at Detroit	3,500.00
Total	5,000.00

All of which is provided for by indefinite appropriation (section 4 of the river and harbor act of June 5, 1884.)

Total expenditure to June 30, 1890	$57,220.10
Expended during fiscal year	1,933.20
Total expenditure to June 30, 1891	59,153.30

(See Appendix O O 14.)

15. *Clinton River, Michigan.*—In 1870 the channel over the bar at the entrance to this river afforded a depth of only 3½ feet, while the depth in the river for some distance above was 10 feet.

A project for dredging a channel across the bar was approved and carried into effect in 1870. A project for the general improvement of the river from its mouth to the city of Mount Clemens was submitted in 1880, and renewed and approved in 1889. It contemplates a navigable depth of 8 feet for the entire distance, and involves closing Catfish (or Blind) Channel and making a straight cut across Shoemaker Bend, constructing a revetment on the north side of the mouth from the shore to the requisite depth in Lake St. Clair, and dredging wherever necessary to attain the desired depth; the estimated cost of the improvement being $32,926.

By June 30, 1890, Catfish Channel had been closed, and the straight cut at Shoemaker Bend was finished, a channel 52 feet wide and 8 feet deep had been made at the mouth of the river, shoals had been removed at Moore Bend and Mount Clemens, and work was still in progress under contract with Messrs. Hubbell & Skeldon, dated September 10, 1889, the contractors being engaged at the time in removing the shoal at Green Fence Bend.

Work under this contract was continued until August 10, 1890, when the contractors had removed 10,879 cubic yards, scow measure, since the beginning of the fiscal year, and funds were exhausted.

The river and harbor act of September 19, 1890, appropriated $10,000 for continuing the improvement, and under contract with Mr. George Lockerbie, dated February 13, 1891, 15,027 cubic yards, scow measure, has been excavated during the fiscal year, and work is still in progress. On June 30, 1891, a channel 8 feet deep and 75 feet wide extended from the mouth of the river to Williams Bend, 2½ miles below Mount Clemens.

Eight thousand five hundred and sixty-four dollars and fourteen cents still remains to be appropriated to complete the improvement in accordance with the present project; and in view of the relief already afforded the river is worthy of the additional appropriation. This amount can be profitably expended during the fiscal year ending June 30, 1893.

Total expenditure to June 30, 1890		$38,907.95
Expended during fiscal year		6,497.11
Total expenditure to June 30, 1891		45,405.06
July 1, 1890, balance unexpended		5,261.53
Amount appropriated by act approved September 19, 1890		10,000.00
		15,261.53
June 30, 1891, amount expended during fiscal year		7,290.04
July 1, 1891, balance unexpended		7,971.49
July 1, 1891, outstanding liabilities	$1,863.43	
July 1, 1891, amount covered by uncompleted contracts	6,108.06	
		7,971.49
Amount (estimated) required for completion of existing project		8,564.14
Amount that can be profitably expended in fiscal year ending June 30, 1893		8,564.14
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix O O 15.)

16. *Grosse Pointe Channel, Michigan.*—Between the lower end of St. Clair Flats and the deep water of Detroit River, the only known obstruction to navigation is the large shoal off Grosse Pointe, known as Grosse Pointe Flats. At ordinary stages of water vessels drawing 16 feet can cross this obstruction, but when the water is as low as it has been during the last few years vessels drawing more than 15 feet can pass only with great care and difficulty.

The river and harbor act of August 11, 1888, appropriated $75,000 for "improving St. Clair Flats Ship Canal, * * * all or any portion of which may, in the discretion of the engineer, be expended in dredging Grosse Pointe Channel." Five thousand dollars was consequently reserved from this appropriation for the removal of any small and well-defined obstruction that might be found at Grosse Pointe, as well as for making such surveys as might be necessary before making a definite project. A small shoal was removed in July, 1889, but no more such obstructions have since been found.

As the improvement of other connecting channels of the Great Lakes begins to approach the 20 foot depth, which it is recognized that they should ultimately have, the annoyance to shipping at Grosse Pointe Flats must increase, and the necessity for a channel at this point is urgent. The number of vessels annually crossing these flats is enormous, and to insure a thoroughly satisfactory result a channel 800 feet wide and nearly 5½ miles long should be dredged and the full depth of 20 feet should be obtained at whatever cost. The approximate estimate for this work is as follows:

Dredging 2,889,472 cubic yards at 30 cents	$869,841.60
Add 10 per cent. for contingencies	86,984.16
Total	956,825.76

The commerce which passes this point already exceeds 20,000,000 tons annually, and steps can not be taken too soon for its accommodation. To accomplish valuable results a large appropriation will be required at first, and unless this be granted the results will be unsatisfactory and the eventual cost will be greatly increased. With $300,000 available, a narrow channel of the proposed depth can be opened and will afford immediate though insufficient relief. The width can subsequently be increased to such an extent as may be necessary.

Total expenditure to June 30, 1890	$1,155.95
Total expenditure to June 30, 1891	1,155.95
July 1, 1890, balance unexpended	3,844.05
July 1, 1891, balance unexpended	3,844.05
Amount (estimated) required for completion of existing project	956,825.76
Amount that can be profitably expended in fiscal year ending June 30, 1893	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 16.)

17. *Rouge River, Michigan.*—Before improvements were begun Rouge River had a channel of 11 feet over the bar at its mouth, and from 10 to 17 feet thence to the bridge of the St. Louis and Wabash Railroad, a distance of nearly 15,000 feet. In earlier days vessels had ascended it to Dearborn, a distance of about 15 miles.

The approved project for improvement contemplates dredging the river to a depth of 16 feet and width of 240 feet at the mouth, gradually narrowing to 100 feet at a distance of about 1,150 feet above, and then continuing this width to the bridge of the St. Louis and Wabash Railroad, a total distance of about 15,000 feet.

On June 30, 1890, the channel dredged under the appropriation of August 11, 1888, was 16 feet, 240 feet wide at the mouth, gradually narrowing to 100 feet at a distance of about 1,150 feet above, and from there on for an additional distance of about 7,600 feet it was 60 feet wide at bottom except at curves, where the bottom width was about 80 feet, the total length of the dredged channel being about 8,750 feet.

The $10,000 appropriated September 19, 1890, was expended in dredging under contract with Messrs. Breymann Bros., dated November 6, 1890, and resulted in the removal of 90,189 cubic yards of material. After the completion of this contract the dredged channel was 16 feet deep, 240 feet wide at the mouth, gradually narrowing to 100 feet at a distance of about 1,150 feet above, and from there to the Michigan Central Railroad Bridge, an additional distance of about 11,500 feet, it averaged 70 feet in width, being wider at the curves, the total length of the dredged channel being about 12,650 feet.

To complete this improvement in accordance with the original estimate an additional appropriation of $11,690.39 will be necessary. In view of the increasing number of manufacturing establishments along its banks and of its use as a winter harbor for vessels, the river is well worthy of the additional appropriation necessary to complete the project for its improvement.

Total expenditure to June 30, 1890	$10,491.45
Expended during fiscal year	9,991.83
Total expenditure to June 30, 1891	20,483.28
July 1, 1890, balance unexpended	125.00
Amount appropriated by act approved September 19, 1890	10,000.00
	10,125.00
June 30, 1891, amount expended during fiscal year	9,991.83
July 1, 1891, balance unexpended	133.17
Amount (estimated) required for completion of existing project	11,690.39
Amount that can be profitably expended in fiscal year ending June 30, 1893	11,690.39
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 17.)

18. *Detroit River, Michigan.*—Originally the channel at Lime Kiln Crossing, Detroit River, could not be depended upon for more than 13 feet of water, the ordinary depth being much affected by the direction of the wind. As originally projected in 1874, the improvement at this point was to consist of a curved channel 300 feet wide, with a uniform depth of 20 feet, and the original estimate was based upon this project.

In 1883 it was wisely determined to so modify the project as to secure a straight channel, the least width of which should be 300 feet, with a somewhat greater width at each end, utilizing the work already done.

In 1886 this was further modified to the end that the width of the channel should be increased to 400 feet by removing an additional 100 feet from the western (American) side; and in 1888 a further additional width of 40 feet on the western side was authorized, as the lowest bid under the final appropriation was so low that the money in hand would pay for the increased excavation.

Under the contract with Messrs. Dunbar & Sullivan, dated October 30, 1888, work was carried on from the beginning of the fiscal year until October 1, 1890, when the channel was completed to a depth of 20 feet and width of 440 feet, and some shoals in the vicinity were removed to the same depth; 1,213 cubic yards of solid rock and 1,584 cubic yards of loose rock were removed by the contractors during the fiscal year; and range lights have been established by the United States and Canadian governments to mark the completed channel.

The extent to which this improvement is used is shown by the fact that in the calendar year 1890 35,640 American vessels, having 21,684,000 tons register passed through Detroit River. If records of the Canadian vessels could be obtained a still larger showing would be made.

Total expenditure to June 30, 1890	$692,099.48
Expended during fiscal year	10,022.56
Total expenditure to June 30, 1891	702,122.04

The project for Lime Kiln Crossing having been completed, no further estimate is submitted for work at that point. Owing to the low water of the last few years, however, vessels have struck on a number of shoals in different parts of the river, and, in view of the magnitude of the commerce affected, all such shoals should be removed as soon as possible. An estimate of $50,000 is therefore made for the removal of the more serious of these shoals between the city of Detroit and Lake Erie.

July 1, 1890, balance unexpended	$27,869.75
June 30, 1891, amount expended during fiscal year	26,881.38
July 1, 1891, balance unexpended	988.37

Amount (estimated) required for removing shoals	50,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix O O 18.)

19. *Removing sunken vessels or craft obstructing or endangering navigaton.*—The coal-laden schooner *M. E. Tremble* was sunk by collision on September 8, 1890, in the rapids of St. Clair River opposite Fort Gratiot, Mich., and its removal was authorized by the War Department. Before the end of the time set in the 30 days' notice required by law, notification was received from Mr. Thomas Murphy, of Detroit, that he had acquired sole ownership in the wreck, and proposed to remove it

himself. The Government was therefore prevented from proceeding further in the matter.

On November 8, 1890, while Mr. Murphy was working on the wreck, his tender, the *Ben Hur*, was run into and sunk so as to rest partly on the wreck of the *Tremble*. This necessitated a new 30 days' notice and the issuing of new specifications for the removal of both vessels.

No further notification having been received from the owner of the wrecks, a contract for their removal to a clear depth of 35 feet was duly entered into with the Charlton Tug Line of Detroit, on January 26, 1891, for the lump sum of $4,900.

The contractors began work March 26. They used large charges of dynamite placed in position by divers, and finished work June 2, 1891. No points at the site of the wrecks or in the vicinity being found with less than 35 feet of water over them, the contractors were paid in full on June 17, 1891, and the contract was closed. The total cost to the Government, including superintendence, printing, advertising, etc., was $5,241.05. No articles of value were recovered.

(See Appendix O O 19.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Colonel Poe, and reports thereon submitted. It is the opinion of Colonel Poe, based upon the facts and reasons given, that these localities are not worthy of improvement. This opinion being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Sebewaing River, Michigan, with a view of deepening the channel from the mouth to the village of Sebewaing to the depth of 8 feet.*—Printed as House Ex. Doc. No. 154. (See also Appendix O O 20.)

2. *The American channel of the Detroit River, Michigan, beginning at the western boundary of the city of Detroit, and from thence continuously in American waters to Lake Erie, with a view to deepening said channel to the same depth as has been attained and is contemplated under present plan in the Canadian channel of said river, the said survey to be made in the channel of said river fronting the towns of Springwells, Ecorse, Monquagon, and Brownstown, and the American shore of said river to such a point in Lake Erie as may be necessary to reach a proper depth of water in said lake to correspond with the increased depth of the river contemplated.*—Printed as House Ex. Doc. No. 43. (See also Appendix O O 21.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Colonel Poe, and reports thereon were submitted. . It is the opinion of Colonel Poe, based upon the facts and reasons given, that these localities are worthy of improvement. The reports of the preliminary examinations containing sufficient information to indicate to Congress the probable cost of the work required, no further surveys appear to be necessary at this time. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Ship channel 20 feet in depth and of a suitable width in the shallows of the connecting waters of the lakes between Chicago, Duluth, and Buffalo.*—Two estimates are submitted, one for obtaining the depth (20 feet)

specified by the act, and the other for a depth of 21 feet where necessary in localities subject to heavy seas, as follows:

For a 20-foot channel	$2,379,085.16
For a 20 and 21 foot channel	3,339,567.96

Printed as House Ex. Doc. No. 207. (See also Appendix O O 22.)

2. *Corsica Shoal, Michigan, situated at the lower end of Lake Huron, near the entrance to the St. Claire [Clair] River, with a view to its removal.*—The improvement proposed contemplates obtaining a depth of 21 feet by dredging, the cost of which is estimated at $410,666. Printed as House Ex. Doc. No. 225. (See also Appendix O O 23.)

3. *Rouge River, Michigan, with a view of locating and constructing basin in said river, at a point on the same within 4 miles of its junction with the Detroit River, convenient for the turning and anchoring of vessels in the same.*—The improvement proposed contemplates the excavation of the basin specified, to a length of 500 feet and width of 250 feet, at an estimated cost of $15,611.10. Printed as House Ex. Doc. No. 115. (See also Appendix O O 24.)

IMPROVEMENT OF RIVERS AND HARBORS ON LAKE ERIE, WEST OF ERIE, PENNSYLVANIA.

Officer in charge, Maj. L. Cooper Overman, Corps of Engineers, with Lieut. William V. Judson, Corps of Engineers, under his immediate orders since April 5, 1891; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Monroe Harbor, Michigan.*—The original project for the improvement of this harbor was adopted in 1835, when Monroe was a town of considerable importance, and when the navigable waters of the River Raisin were separated from the waters of Lake Erie by extensive shoals. It provided for cutting a canal through River Raisin Point between the river and the lake, 4,000 feet long and 100 feet wide, and protecting the entrance into the lake by parallel piers, the object being to afford a channel of entrance of navigable width, with a depth of 10 feet. Work was commenced in 1835 and has been continued from time to time since that date.

Act of Congress approved September 19, 1890, appropriated for this harbor $5,000, all of which sum was expended in repairs in accordance with terms of the appropriation. No other work was done during the fiscal year.

The total amount appropriated for this harbor has been $225,515.27, all of which has been expended.

At the close of the last fiscal year there was a fair channel with a least depth of 8 feet, up to a point below Monroe where rock bottom exists, which is deemed sufficient for the present commerce of the port, provided an annual expenditure of, say, $1,000 is appropriated for dredging.

If the harbor is to be kept up there is need of extensive repairs of piers and canal revetment, in order to prevent their ultimate destruction. These are estimated to cost $20,000, and at least $5,000 will be required annually for preservation of piers and revetment.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	5,000.00

Amount that can be profitably expended in fiscal year ending June 30, 1893 $26,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P P 1.)

2. *Toledo Harbor, Ohio.*—The original project provided for making the existing channel 200 feet wide and 12 feet deep through Maumee Bay, and this was amended from time to time, resulting in the present project, which provides for a width of 200 feet at bottom, and a depth of 16 feet at low water between the city of Toledo and deep water in Lake Erie.

The total amount appropriated for this harbor for the several projects for improving the natural channel, from 1866 to close of fiscal year ending June 30, 1891, is $723,916.60, of which $719,016.57 has been expended, and has resulted in obtaining a channel with least depth of 15½ feet where before there was a narrow intricate channel with but 11 feet depth.

Act of September 19, 1890, appropriated for improvement of this harbor for "clearing old channel," $5,000. Contract for dredging was entered into and work commenced in May, which was still in progress at close of fiscal year.

The estimated cost of the present project for natural channel was $570,000, which will not complete the project as originally estimated, owing to the time consumed in doing the work for want of adequate appropriation; the annual removal of deposits of each winter and spring, repeated for 14 years, and other necessary expenses, having absorbed at least $100,000 of the original estimate. Five hundred and twenty-nine thousand three hundred and forty-six dollars and ninety-one cents of the original estimated cost has been appropriated for this improvement; it will therefore require at least $140,000 to complete the deepening and widening of the natural channel between Toledo and 16 feet of water in Lake Erie, after which an annual expenditure of about $20,000 will be needed to maintain the dredged channel through the open bay, or until the "straight channel improvement" is completed.

The latest project for the improvement of Toledo Harbor, Ohio, provides for a straight channel through Maumee Bay from the city of Toledo to deep water in the lake.

Appropriations of 1884, 1886, and 1888 for the straight channel, amounting to $287,500, have all been expended on this improvement (excepting $9,346.91 transferred to old channel).

There was appropriated by act of September 19, 1890, for improvement by straight channel $200,000. Contracts were made with Messrs. L. P. & J. A. Smith, of Cleveland, Ohio, and Mr. James Rooney, of Toledo, Ohio, for dredging 825,000 cubic yards, as follows: 800,000 cubic yards from straight channel and 25,000 cubic yards from old channel. Contract for construction of pile protection around range-light cribs in Maumee Bay was made with Mr. John Kelly, of Guttenburg, N. J.

These contracts provide for the expenditure of entire appropriation of 1890. Work under same commenced in May and was in progress at the close of fiscal year 1891.

The total amount appropriated for straight channel improvement has been $487,500, of which sum there has been expended on said improvement to the close of fiscal year ending June 30, 1891, $286,470.55.

The amount of work done on the straight channel, as compared with the entire project, can not be of full practical benefit to navigation

until completed, nor can any comparisons yet be made as to benefits to be derived.

Straight channel.

July 1, 1890, balance unexpended		$13,704.46
Amount appropriated by act approved September 19, 1890		200,000.00
		213,704.46
June 30, 1891, amount expended during fiscal year		22,021.92
July 1, 1891, balance unexpended		191,682.54
July 1, 1891, outstanding liabilities	$1,870.64	
July 1, 1891, amount covered by uncompleted contracts	173,943.51	
		175,814.15
July 1, 1891, balance available		15,868.39
Amount (estimated) required for completion of existing project		1,400,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		600,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Old channel.

July 1, 1890, balance unexpended		$99.96
Amount appropriated by act approved September 19, 1890		5,000.00
		5,099.96
June 30, 1891, amount expended during fiscal year		199.93
July 1, 1891, balance unexpended		4,900.03
July 1, 1891, amount covered by uncompleted contracts		4,500.00
July 1, 1891, balance available		400.03
Amount (estimated) required for completion of existing project		140,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		40,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P P 2.)

3. *Port Clinton Harbor, Ohio.*—In 1870 the channel at the entrance to this harbor was narrow and intricate, with a depth of only 5 feet.

The present project, adopted in 1875, provides for a pile revetment from the north shore of the Portage River, opposite the town, 967 feet into the lake, and two pile-piers, 200 feet apart, of an aggregate length of 4,100 feet, extending to the depth of 10 feet in the lake, with a view of maintaining a depth of 9 feet between them.

The act of September 19, 1890, appropriated $3,000 for this harbor. A contract for dredging for the entire amount has been made, work to be done in July, 1891. In addition to the dredging considerable repairs are needed.

The total amount appropriated for this harbor to the close of the fiscal year ending June 30, 1891, has been $56,000, of which there has been expended $53,000, and has resulted in obtaining a depth of 8 feet from the lake to the town. The proposed improvement is only about one-half finished.

Amount appropriated by act approved September 19, 1890		$3,000.00
July 1, 1891, balance unexpended		3,000.00
July 1, 1891, amount covered by uncompleted contracts		2,800.00
July 1, 1891, balance available		200.00

Amount (estimated) required for completion of existing project.....	$37,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 3.)

4. *Sandusky City Harbor, Ohio.*—The original depth in the channel through the outer bar was 10 feet and greatest depth in bay about 12 feet.

The project adopted in 1880 provided for a channel through the outer bar and through the bay 200 feet wide, and parallel to the city docks 100 feet wide, the whole to be 15 feet deep.

An increased depth of 17 feet at low water in the old channel is recommended for this harbor by the officer in charge on account of the increased size of vessels navigating the lakes. The estimated cost of this extra depth is $61,000.

An annual removal of at least 10,000 cubic yards is necessary to maintain the unfinished old channel, after which the additional dredging, where funds permit, can be applied toward the completion of the channel to 200 feet in width and 15 feet in depth, or until new channel is available.

Approved project of 1888 provides for a "straight channel" for this harbor 200 feet wide and 17 feet deep, extending from the east end of the dock channel to the north end of Cedar Point. This new channel will materially shorten and improve the existing entrance. The estimated cost of straight channel as projected is $96,712; of this amount there has already been appropriated, by acts of Congress of 1888 and 1890, the sum of $80,000, more or less.

Act of September 19, 1890, appropriated for improving harbor at Sandusky, Ohio, $45,000.

Contracts were made for dredging which provide for the expenditure of above amount. Work of dredging commenced in May and was in progress at close of fiscal year 1891.

At the close of the fiscal year ending June 30, 1891, there had been expended on the old channel improvement the sum of $274,518.73, resulting in a channel through the outer bar about 150 feet wide, having a depth of about 15 feet, in which for a width of 50 feet there was a depth of 16½ feet, and through the bay up to a point 50 feet from the line of docks a width of 150 feet and least depth of about 14½ feet.

At the close of the fiscal year there had been expended on the straight channel a total of $41,199.07.

Amount appropriated by act approved September 19, 1890.....		$45,000.00
June 30, 1891, amount expended during fiscal year.....		4,637.80
July 1, 1891, balance unexpended		40,362.20
July 1, 1891, outstanding liabilities.....	$533.92	
July 1, 1891, amount covered by uncompleted contracts.....	36,636.82	
		37,170.74
July 1, 1891, balance available		3,191.46

Amount (estimated) required for completion of existing project.....	41,712.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	41,712.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 4.)

5. *Sandusky River, Ohio.*—During the years 1867 and 1872 the sum of $30,000 was expended in opening a navigable channel with a depth of

8 feet from Sandusky Bay to Fremont, a distance of 17 miles. Since 1872 the cuts then made through the various bars filled up.

The present project, which was based on a survey made in compliance with the river and harbor act of 1880, provides for opening a channel 100 feet wide and 9 feet deep between the town of Fremont and the depth of 9 feet in Sandusky Bay, at an estimated cost of $44,000.

At the close of the fiscal year ending June 30, 1883, the sum of $21,500 had been appropriated for the present project, all of which has been expended. No further appropriation was made until the year 1890.

Act of September 19, 1890, appropriated for this improvement $1,500. A contract for this amount to be expended in dredging was made with Carkin, Stickney & Cram, of East Saginaw, Mich., work to be completed in July.

There was at the close of the season 1890 a fair channel, with least depth of 8 feet from Fremont, the head of navigation, to the lake. Some complaints have been made of the shoaling of the old cuts. The removal of a majority of these shoals, it is thought, will be accomplished by the completion of the dredging under existing contract, and the ultimate completion be sufficient for the demands of commerce.

July 1, 1890, balance unexpended	$439.47
Amount appropriated by act approved September 19, 1890	1,500.00
	1,939.47
June 30, 1891, amount expended during fiscal year	439.47
July 1, 1891, balance unexpended	1,500.00
July 1, 1891, amount covered by uncompleted contracts	1,400.00
July 1, 1891, balance available	100.00
Amount (estimated) required for completion of existing project	21,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 5.)

6. *Huron Harbor, Ohio.*—The project for the improvement of this harbor was adopted in 1826, when the mouth of the river was closed by a sand bar. This project has been amended from time to time as the demands of commerce called for an increased depth of channel, and now consists of parallel piers 140 feet apart, extending to the depth of 16 feet in the lake.

At the close of the fiscal year ending June 30, 1891, there was a good channel through the outer bar with a depth of 15½ feet, and between the piers with a depth of from 16 to 17 feet. The superstructure of both piers, except where repaired in 1884, 1886, 1888, and 1891, was in a decayed condition and needed immediate renewal.

The heavy spring gales during late years have done considerable damage to the piers and to the beaches, so that a breach was probable at the inner end of east pier near the shore, but repairs of 1890 and 1891 have made it secure.

By act of September 19, 1890, there was appropriated the sum of $16,000.

Contract was at once made with John Stang, of Lorain, Ohio, for repairs to the piers, which work was the most urgent.

These repairs were commenced in the fall of 1890 and completed in May following, the sum of $4,469.09 being expended thereon, and by which the piers were temporarily placed in fair condition.

Contract was made for dredging with Messrs. Carkin, Stickney & Cram, of East Saginaw, Mich. Under this contract work was commenced in March and completed by May 7, a total of 8,092 cubic yards of material was removed, and full depth of 16 feet secured for channel between piers and through bar in lake.

A contract for the extension of west pier 120 feet was entered into with John Stang, of Lorain, Ohio. Work was commenced in May, after completion of the repairs, and was still in progress at close of the fiscal year.

Up to the end of fiscal year 1891 the sum of $139,273.71 had been appropriated for this harbor, of which has been expended the sum of $128,469.43. A good channel with least depth of 16 feet has been secured where originally there was a sand bar dry at low water.

Considerable repairs are still needed, and further dredging to secure full width of channel.

The cost of renewing the superstructure of the piers as originally estimated was $22,000, all of which has been appropriated and expended. Repairs in addition to those completed when the estimate was submitted have been made necessary by the storms of 1888, 1889, and 1890, and the additional amount asked for to completely renew the piers is $12,000.

The present approved project, as amended in 1890, provides for extension of piers to the depth of 16 feet in the lake, and dredging, at an estimated cost of $22,000; of this amount there is yet to be appropriated the sum of $13,600.

It is recommended by the officer in charge of this work that provision be made to give 17 feet depth at this harbor, at an estimated cost of $28,000, in addition to the amount required to complete existing project, $25,600.

Amount appropriated by act approved September 19, 1890		$16,000.00
June 30, 1891, amount expended during fiscal year		5,195.72
July 1, 1891, balance unexpended		10,804.28
July 1, 1891, outstanding liabilities	$2,023.00	
July 1, 1891, amount covered by uncompleted contracts	8,422.30	
		10,445.30
July 1, 1891, balance available		358.98
Amount (estimated) required for completion of existing project		13,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		*25,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix P P 6.)

7. *Vermillion Harbor, Ohio.*—Before improvement, the mouth of the Vermillion River was closed by a sand bar, upon which there was a depth of less than 2 feet. The original project consisted of parallel piers running out into the lake from each side of the mouth of the river, in order to secure a depth of 10 feet. This project has been amended from time to time, and now provided for a depth of 14 feet.

In 1878 the channel was about 70 feet wide, with a depth of about 12 feet, and has since remained nearly permanent.

The act of September 19, 1890, made an appropriation of $2,000 for this harbor for repairs. Only partial repairs to the piers can be made with the sum available, which repairs will be made during the fall of 1891.

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* This amount includes, in addition to estimate for completion of existing project ($13,600), an estimate for renewal of piers ($12,000).

At the close of the fiscal year ending June 30, 1891, the piers were in only fair condition; the depth in the channel was about the same as at close of the previous fiscal year, viz, 10 feet. The amount appropriated to close of fiscal year 1891 has been $120,942.32, of which the sum of $118,942.32 has been expended.

Amount appropriated by act approved September 19, 1890	$2,000.00
July 1, 1891, balance unexpended	2,000.00
Amount (estimated) required for completion of existing project	8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 7.)

8. *Black River Harbor, Ohio.*—The original preject for the improvement of this harbor was adopted in 1828, and amended from time to time as the demands of commerce called for an increased depth of channel. The present project provides for parallel piers 200 feet apart, running out to a depth of 16 feet in the lake.

Up to the close of the fiscal year ending June 30, 1890, and since 1826, the sum of $220,138.73 has been expended, with which a channel with least depth of 16 feet has been obtained, where originally there was but 3 feet at the entrance. The act of September 19, 1890, appropriated $12,000 for this harbor.

A contract for repairs to piers was executed with John Stang, of Lorain, Ohio. Work was commenced in fall of 1890 and finished in May, 1891, the total expenditure for same being $2,255.29.

Contract for dredging required was made with Messrs. Carkin, Stickney & Cram, of East Saginaw, Mich. Under this contract there was removed a total of 6,400 cubic yards of material.

Contract for extension of east pier 102 feet was entered into with John Stang, of Lorain, Ohio. Work was commenced in May, after completion of repairs, and was in progress at close of fiscal year.

The dredging done during the fiscal year has placed the channel in good condition. By the repairs the structures have been temporarily placed in fair condition. The piers need considerable renewal of superstructure.

The unexpected and extra repairs made and to be made at this harbor will increase the estimate for same, and the renewal and prolonging of the piers and dredging will cost $18,000.

Only one-third of the proposed extension of the piers has been accomplished. This is the most important work, and should be completed as soon as funds sufficient are available.

The total amount appropriated for this harbor to close of fiscal year 1891 has been $232,138.73, of which the sum of $222,861.96 has been expended.

It is recommended by the officer in charge of this work that provision be made to give 17 feet depth at this harbor, at an estimated cost of $40,000.

Amount appropriated by act approved September 19, 1890		$12,000.00
June 30, 1891, amount expended during fiscal year		2,723.23
July 1, 1891, balance unexpended		9,276.77
July 1, 1891, outstanding liabilities	$1,680.00	
July 1, 1891, amount covered by uncompleted contracts	6,974.51	
		8,654.51
July 1, 1891, balance available		622.26

Amount (estimated) required for completion of existing project	$18,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	*58,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 8.)

9. *Cleveland Harbor, Ohio.*—The original project for the improvement of the mouth of Cuyahoga River was adopted in 1825, and has been amended from time to time to gain increased depth. It consists of parallel piers about 200 feet apart, running out to a depth of 16 feet in the lake.

When operations were commenced there was a long, low sand bar where the river now empties into the lake, and the entrance was through a narrow, intricate channel with a depth of about 3 feet.

During the fiscal year ending June 30, 1891, minor repairs were made to piers and west breakwater at a total expenditure for materials and labor of about $2,000.

At the close of the fiscal year ending June 30, 1891, there had been expended about $377,000, and there was as a result a good, wide channel at the entrance of the harbor with a depth of from 14 to 16 feet between the railroad bridge at the inner end of the piers and the lake, with a pile protection work 620 feet long at the inner end of the west pier, constructed in 1882.

Harbor of refuge.—The original project provided for an outer breakwater starting from the lake shore, about 700 feet west of the upper end of the old river bed.

The west breakwater runs out about due north a distance of 3,130 feet to a depth of 28 feet, and thence for 4,030 feet it runs nearly parallel to the shore, with a spur 100 feet long on the north side of the lake arm, 200 feet from its eastern end, in a depth of from 28 to 30 feet. It was originally proposed to protect the entrance to the harbor on the east side by extending the east pier at the mouth of the river 1,400 feet.

Amended projects changed this plan, and now provide for a breakwater on the east side, which begins at a point on the prolongation of the arm of the west breakwater and 500 feet from it, extends eastward on the line about 3,500 feet, then inclines toward the shore in a depth of 26 feet of water, and extends 2,000 feet, having an entrance 2,300 feet wide between the eastern end and the curve of 14 feet depth of water, or about 2,200 feet from shore.

Act of September 19, 1890, appropriated for this harbor $75,000.

Contract for construction of 450 linear feet of foundation for structure of breakwater was made with the Kelley Island Lime and Transport Company. Work was commenced in the fall of 1890, and completed in May, 1891, and contract closed.

Contracts for construction of the structure of 450 linear feet of breakwater and the iron required for same were entered into with Messrs. L. P. & J. A. Smith, of Cleveland, Ohio, and Wallace M. Pattison, of Cleveland, Ohio, respectively.

The iron was all prepared and the delivery completed by May, 1891, and contract closed. Work of crib construction commenced in May and was in progress at close of fiscal year ending June 30, 1891.

Contract was entered into with Messrs. Carkin, Stickney & Cram, of East Saginaw, Mich., for dredging from channel and from basin of breakwater. About 13,300 cubic yards of material were removed dur.

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*This amount includes, in addition to estimate for completion of existing project ($18,000), an estimate for increase of depth to 17 feet ($40,000).

ing May and June, 1891, under this contract, restoring the usual depth of 16 feet of water throughout the channel.

The total amount expended during the fiscal year was $18,821.65, of which the sum of $2,000 was expended in repairs and dredging.

At the close of the fiscal year 1890 a total of about $1,051,000 had been expended, and 8,860 linear feet of breakwater had been finished, which completes the west breakwater and over 1,700 linear feet of the east breakwater, leaving to be built to complete the harbor of refuge about 3,800 linear feet of east breakwater, with provision made under present appropriation of 1890 for construction of 450 linear feet of this latter amount, now under contract as aforementioned.

The total amount appropriated for the harbor of refuge to July 1, 1891, is $1,168,750, of which sum, $1,112,399.85 has been expended therefor, less about $44,000, which has been applied to repairs to piers, dredging, etc., for Cleveland Harbor proper in a period of 16 years.

July 1, 1890, balance unexpended		$171.80
Amount appropriated by act approved September 19, 1890		75,000.00
		75,171.80
June 30, 1891, amount expended during fiscal year		18,821.65
July 1, 1891, balance unexpended		56,350.15
July 1, 1891, outstanding liabilities	$255.00	
July 1, 1891, amount covered by uncompleted contracts	52,006.47	
		52,261.47
July 1, 1891, balance available		4,088.68
Amount (estimated) required for completion of existing project		444,250.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		444,250.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix P P 9.)

10. *Fairport Harbor, Ohio.*—When the work was commenced in 1826, the mouth of the river was closed by a sand bar 1,200 feet wide, at times so hard and dry that teams could cross over it.

The present project for the improvement of this harbor consists of parallel piers, 200 feet apart, running into the lake. It was adopted in 1825, and has been modified by prolonging the piers from time to time so as to give increased depth, the object now being to afford a channel of navigable width and not less than 16 feet in depth.

The act of September 19, 1890, made an appropriation of $30,000 for this harbor and Grand River.

Contracts were entered into with the American Transportation Company, of Painesville, Ohio, for dredging, and with Quartus Gillmore, of Lorain, Ohio, for extension of east pier 120 feet and west pier 80 feet, and general repairs to piers.

Dredging was commenced in fall of 1890, continued in spring of 1891, and was in progress at close of the fiscal year.

The amount expended during the fiscal year ending June 30, 1891, is $8,596.29.

At the close of the fiscal year ending June 30, 1890, there was a fair channel between the piers with a least depth of 16 feet at low water, and in lake beyond end of piers, with a least depth of 15½ feet at ordinary level of the lake, but not for full width needed. Increased depth and width is well provided for under present appropriation. This will be accomplished by the completion of dredging under existing contract.

Extensive improvements as to docks and yards for receiving cargoes

of iron ore and shipping coal have been made by Pittsburg capitalists, during the past 3 years, at Fairport Harbor and at Richmond, 2 miles up stream, where elevators for grain have been built.

These improvements have caused a large increase of business at this harbor.

This increased commerce demands increased channel depth, and as a consequence additional extension of piers.

The total amount appropriated for this harbor up to the close of fiscal year 1891 has been $296,531.68, of which $275,127.97 has been expended.

Amount appropriated by act approved September 19, 1890		$30,000.00
June 30, 1891, amount expended during fiscal year		8,596.29
July 1, 1891, balance unexpended		21,403.71
July 1, 1891, outstanding liabilities	$667.27	
July 1, 1891, amount covered by uncompleted contracts	17,544.96	
		18,212.23
July 1, 1891, balance available		3,191.48
Amount (estimated) required for completion of existing project		114,400.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		64,400.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix P P 10.)

11. *Ashtabula Harbor, Ohio.*—The original project for the improvement of this harbor was adopted in 1826. Rock bottom was then found at 9 feet below the surface, and there was a depth of only 2 feet of water on the bar at the entrance.

A later amended project contemplated the extension of the piers out to 16 feet depth of water, the removal of the decayed portions of both piers and rebuilding with new material, at the same time straightening the line of the west pier so as to afford a uniform width of 160 feet in channel.

The present project, adopted in 1891, provides for a width of 205 feet between piers and a depth in channel between piers of 20 feet; the piers to be extended to the depth of 22 feet in the lake.

At the close of the year 1890 there was a good wide channel, 15½ to 16 feet deep, from the lake into the harbor.

The act of September 19, 1890, appropriated the sum of $40,000 for this harbor.

Contract was made with Messrs. Carkin, Stickney & Cram, of East Saginaw, Mich., for the rock excavation and dredging provided for in the project submitted for the expenditure of the funds appropriated. Work commenced in May and was in progress at close of the fiscal year ending June 30, 1891, but a small portion of the 29,000 cubic yards contracted for having been removed.

The channel through the outer bar is being excavated to 18 feet depth and full width. The channel between the piers is being excavated to 17 feet depth and 169 feet width under the present contract.

The work of removing a portion of east pier and relocating same 45 feet to the eastward of its present position had not been commenced at the close of fiscal year on account of inability to obtain satisfactory offer for the work.

The amount expended during fiscal year was $985.23.

The total amount appropriated for this harbor has been $467,401.21, of which $428,310.72 has been expended.

July 1, 1890, balance unexpended		$75.72
Amount appropriated by act approved September 19, 1890		40,000.00
		40,075.72
June 30, 1881, amount expended during fiscal year		985.23
July 1, 1891, balance unexpended		39,090.49
July 1, 1891, outstanding liabilities	125.00	
July 1, 1891, amount covered by uncompleted contracts	29,000.00	
		29,125.00
July 1, 1891, balance available		9,965.49

Amount (estimated) required for completion of existing project	314,392.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix P P 11.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER, 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Overman, and reports thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Major Overman, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Major Overman was charged with their survey, the reports on which will be submitted when received.

1. *Grand River, Ohio, between Richmond and the mouth.*
2. *Conneaut Harbor, Ohio.*

IMPROVEMENT OF ERIE HARBOR, PENNSYLVANIA, AND OF DUNKIRK, BUFFALO, WILSON, OLCOTT, AND OAK ORCHARD HARBORS, AND TONAWANDA HARBOR AND NIAGARA RIVER, NEW YORK.

Officer in charge, Maj. Amos Stickney, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Erie Harbor, Pennsylvania.*—The original survey of this harbor was made in 1819, at which time the channel was narrow and tortuous, with a depth of only 6 feet. In 1823 a plan for the improvement was adopted, and constitutes the present work at the entrance to the harbor, excepting some changes which have been required either on account of the age of the structures already built or other causes.

The piers have been extended from time to time and are now in pretty fair condition. The north pier needs considerable repairs.

The present project contemplated the extension of the piers to the 16-foot curve in the lake, and the maintenance of a channel of navigable width and 16 feet in depth from the harbor inside to the lake outside.

Operations have been prosecuted with more or less interruption and suspension (no work was done from 1838 to 1842, from 1846 to 1853, and from 1855 to 1864), and have resulted in much benefit to the harbor and its channel entrance.

The work during the year consisted of minor repairs to piers; dredging in channel, which has put it in excellent condition; survey of eastern shore of the peninsula and lake east of harbor; and beginning of the work of extending the north pier 450 feet.

The total amount expended up to June 30, 1890, not including outstanding liabilities, was $734,593.19. The amount expended during the fiscal year ending June 30, 1891, was $27,167.91.

July 1, 1890, balance unexpended		$57,274.04
Amount appropriated by act approved September 19, 1890		40,000.00
		97,274.04
June 30, 1891, amount expended during fiscal year		27,167.91
July 1, 1891, balance unexpended		70,106.13
July 1, 1891, outstanding liabilities	$542.04	
July 1, 1891, amount covered by uncompleted contracts	33,525.88	
		34,067.92
July 1, 1891, balance available (includes $20,000 reserved for Presque Isle)		36,038.21
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		60,000.00

(See Appendix Q Q 1.)

2 *Preservation and protection of peninsula at Presque Isle, Erie Harbor, Pennsylvania.*—In a report upon the examination of Erie Harbor made in 1885, it was recommended that the neck of the peninsula be protected by a breakwater, and that the movement of sand around the eastern end of the peninsula, which threatens to close the harbor entrance, be arrested by the construction of jetties perpendicular to the shore of the peninsula, at an estimated cost of $173,044.50.

Work under this project was in progress until October, 1889, when it was abandoned, it having been found that the structures built would not stand against the violence of the storms. No further work is at present contemplated, but the sum of $ -0,000 has been reserved from the appropriation for the improvement of Erie Harbor, to be used in case of necessity, in closing any breach which might occur.

The total amount expended up to June 30, 1890, was $60,000. Nothing was expended during the fiscal year ending June 30, 1891.

(See Appendix Q Q 2.)

3. *Dunkirk Harbor, New York.*—The improvement of this harbor was commenced in 1827, when the first appropriation therefor was made. The original project was much the same as that of the existing improvement, which comprises the formation of an artificial harbor in front of the city by means of a breakwater running nearly parallel with the shore, and a shorearm or pier to the westward, with an opening between the piers and breakwater. By 1832 the sum of $28,489.84 had been expended on the original plan, and the breakwater was then 2,564 feet long and the pier 1,400 feet long.

Various improvements and repairs were made from time to time, and by 1838 there had been completed 2,125 feet of breakwater, and 300 feet of detached breakwater. In 1848 the breakwater was demolished.

Between 1848 and 1870 some portions of the work were renewed and others repaired, but in 1870 a Board of Engineers took into consideration the question of the radical improvement of the harbor. The Board recommended a plan which provided a breakwater 2,860 feet long, one part of which, 2,300 feet in length, was to be nearly parallel with the

shore, the other part to be nearly parallel to the axis of the channel entrance, 500 feet long, and terminating at the position of the dumb beacon, and the formation of a channel 170 feet wide and 13 feet deep; of the 2,300-foot section, 1,341 feet have been completed; none of the 560-foot section has been built.

Work during the year consisted in making a survey of the channel and preparation for repairing parts of the breakwater and West Pier.

The superstructures of breakwater and pier are in very bad condition and need rebuilding. The channel requires considerable rock excavation and dredging to make it 170 feet wide, as proposed. A small amount of dredging will put it in fair condition for a width of 100 feet.

The total amount expended up to June 30, 1890, not including outstanding liabilities, was $492,621.23. The amount expended during the fiscal year ending June 30, 1891, was $531.82.

July 1, 1890, balance unexpended		$1,458.15
Amount appropriated by act approved September 19, 1890		20,000.00
		21,458.15
June 30, 1891, amount expended during fiscal year		531.82
July 1, 1891, balance unexpended		20,926.33
July 1, 1891, outstanding liabilities	$82.81	
July 1, 1891, amount covered by uncompleted contracts	14,970.20	
		15,053.01
July 1, 1891, balance available		5,873.32
Amount (estimated) required for completion of existing project		148,116.41
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix Q Q 3.)

4. *Buffalo Harbor, New York.*—The original project for the improvement of this harbor was adopted in 1826, and, as modified at various times, provided for the construction of piers on the north and south sides of Buffalo Creek, a masonry sea-wall running south from the inshore end of the south pier, and a breakwater less than half a mile in front of the light-house, its long arm being nearly parallel with the shore.

The present project was adopted in 1874, and provides for the construction of a breakwater of crib work 7,600 feet long, running parallel with the shore, and a shore arm of piles and crib work, 4,100 feet long-running out toward the southern end of the main or detached breakwater, leaving an opening of about 150 feet between them.

In 1887 this project was amended so that in the reconstruction of superstructure concrete was substituted for timber crib work.

During the past year the principal work has consisted in making con, crete blocks, tearing down old superstructure and all preparations necessary for rebuilding about 1,970 feet of superstructure in concrete-commencing the work of extending main breakwater 450 feet south, ward; minor repairs to structures; and removing obstructions in rear of breakwater.

The total amount expended up to June 30, 1890, not including outstanding liabilities, was $2,158,097.52.

The amount expended during the fiscal year ending June 30, 1891, was $64,065.47.

July 1, 1890, balance unexpended		$33,382.89
Amount appropriated by act approved September 19, 1890		300,000.00
		333,382.89
June 30, 1891, amount expended during fiscal year		64,065.47
July 1, 1891, balance unexpended		269,317.42
July 1, 1891, outstanding liabilities	$19,623.92	
July 1, 1891, amount covered by uncompleted contracts	114,156.63	
		133,780.55
July 1, 1891, balance available		135,536.87
Amount (estimated) required for completion of existing project		446,223.17
Amount that can be profitably expended in fiscal year ending June 30, 1893		400,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix Q Q 4.)

5. *Tonawanda Harbor and Niagara River, New York.*—The project for this work contemplates a channel 18 feet deep and 400 feet wide from the mouth of the Niagara River at Lake Erie to the north end of Tonawanda Harbor, New York. The work of the year has consisted in excavating about 6,000 cubic yards of rock from the channel, survey of parts of the channel, and preparations for excavating a considerable part of the rock near Strawberry Island, which will provide a fair channel through the reef at this point.

The total amount expended up to June 30, 1890, not including outstanding liabilities, was $73,970.93. The amount expended during the fiscal year ending June 30, 1891, was $31,493.82.

The result of the work during the year was the deepening of a channel 200 feet wide to a depth of 16 feet part of the way through the reef near Strawberry Island.

July 1, 1890, balance unexpended	$26,029.07
Amount appropriated by act approved September 19, 1890	75,000.00
	101,029.07
June 30, 1891, amount expended during fiscal year	31,493.82
July 1, 1891, balance unexpended	69,535.25
July 1, 1891, outstanding liabilities	237.48
July 1, 1891, balance available	69,297.77
Amount (estimated) required for completion of existing project	1,083,690.16
Amount that can be profitably expended in fiscal year ending June 30, 1893	200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q 5.)

6. *Wilson Harbor, New York.*—The project for the improvement of this harbor was adopted in 1873 and modified in 1877, the object being to afford a channel of navigable width and 12 feet in depth by the extension of parallel piers from the mouth of Twelve-Mile Creek to the 12-foot curve in Lake Ontario, with the formation of a protected channel between the piers. The mouth of the creek was originally obstructed by a bar, upon which there was a depth of about 1 foot.

Before the commencement of operations by the United States, the piers had been carried about 400 feet into the lake by private enterprise.

During the year 1888 a protection 360 feet long was built to shield the shore of the lake from the action of waves in gales from the northeast, and prevent a breach being made into the harbor. A section of

the west pier 150 feet long was rebuilt. At the end of the year 1889 dredging operations were closed and a channel with a least depth of 9½ feet had been obtained. The appropriation being exhausted, no work has been done during the past year.

The total amount expended to June 30, 1890, was $64,887.49. The amount expended during the fiscal year ending June 30, 1891, was $12.26.

July 1, 1890, balance unexpended	$112.51
June 30, 1891, amount expended during fiscal year	12.26
July 1, 1891, balance unexpended	100.25
Amount (estimated) required for completion of existing project	13,978.49
Amount that can be profitably expended in fiscal year ending June 30, 1893	*27,455.20
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix Q Q 6.)

7. *Olcott Harbor, New York.*—The project for the improvement of this harbor was adopted in 1866. It proposes to connect the deep water in Lake Ontario with the deep water in Eighteen-Mile Creek by the extension of two parallel piers from the mouth of the creek to the 11-foot curve in the lake, with the addition of a dredged channel between the piers. The project was modified in 1874 and in 1881, to provide for the removal of rock found to exist in the channel between the piers and for additional pier extension. The natural channel between the mouth of the creek and the lake was obstructed by a bar upon which there was a depth of about 1½ feet. The final project, adopted June 18, 1891, definitely fixes the length of the piers at 850 and 873 feet, respectively, and provides for a channel 180 feet wide between piers, decreasing in width to 98 feet at the Main street bridge crossing Eighteen-Mile creek, with a depth of 13.5 feet at mean lake level. During the year the work of thoroughly repairing the piers was commenced and preparations made for completing the channel.

The total amount expended up to June 30, 1890, not including outstanding liabilities, was $132,113.17. The amount expended during the fiscal year ending June 30, 1891, was $589.89.

July 1, 1890, balance unexpended		$886.83
Amount appropriated by act approved September 19, 1890		30,000.00
		30,886.83
June 30, 1891, amount expended during fiscal year		589.89
July 1, 1891, balance unexpended		30,296.94
July 1, 1891, outstanding liabilities	$105.00	
July 1, 1891, amount covered by uncompleted contracts	24,140.36	
		24,245.36
July 1, 1891, balance available		6,051.58

(See Appendix Q Q 7.)

8. *Oak Orchard Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1836, the date of the first appropriation, and proposed the construction of an east and west breakwater, approaching to within 200 feet of each other, and connecting at the opening with two parallel piers extending into the lake.

Subsequent modifications were extensions to the original project to provide for removal of rock, and to adjust the harbor to the increased demand of commerce. The present project was adopted in 1881, the

* This amount includes $13,364.20 required for repairs to existing works.

object being to extend the piers to the 12-foot curve in the lake, with the formation of a channel of navigable width and 12 feet deep at low water between the piers. The natural entrance into Oak Orchard Creek was narrow, with a depth of from 2 to 4 feet.

A shore protection 91 feet long was built in 1888 to the east of the east pier.

During the past year no work was done except surveying the channel, and preparations were made for completing the channel between the piers during the coming season.

The total amount expended up to June 30, 1890, not including outstanding liabilities, was $199,260.14.

The amount expended during the fiscal year ending June 30, 1891, was $254.07.

July 1, 1890, balance unexpended		$739.86
Amount appropriated by act approved September 19, 1890		5,000.00
		5,739.86
June 30, 1891, amount expended during fiscal year		254.07
July 1, 1891, balance unexpended		5,485.79
July 1, 1891, outstanding liabilities	$24.37	
July 1, 1891, amount covered by uncompleted contracts	4,347.00	
		4,371.37
July 1, 1891, balance available		1,114.42

(See Appendix Q Q S.)

EXAMINATION AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Port Day, above Niagara Falls, New York*, was made by the local engineer in charge, Major Stickney, and report thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Major Stickney, and of the Division Engineer, based upon the facts and reasons given, that this locality is worthy of improvement. This opinion being concurred in by me, Major Stickney was charged with its survey, the report on which will be submitted when received.

IMPROVEMENT OF HARBORS ON LAKE ONTARIO, EAST OF OAK ORCHARD, NEW YORK.

Officers in charge, Maj. M. B. Adams, Corps of Engineers, to November 12, 1890, and Capt. Dan. C. Kingman, Corps of Engineers, since that date; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Charlotte Harbor, New York.*—The original project for the improvement of this harbor, adopted in 1829, proposed to connect the deep water in Genesee River with the deep water in the lake by parallel piers about 480 feet apart.

The present project, adopted in 1881, is for the extension of the piers to the 15-foot curve in the lake, with the formation by dredging of a channel between them of a navigable width and 15 feet in depth at low water.

The natural channel over the bar was tortuous, and in calm weather would admit at ordinary stages of the lake vessels drawing 8 feet.

The total amount expended from 1828 to June 30, 1891, is $434,405.73,

including outstanding liabilities; $17,982.56 in addition is covered by existing contracts.

The amount expended from the adoption of the present project in 1881 to June 30, 1891, is $116,327.23, including outstanding liabilities.

The total expenditures have resulted in extending the piers to the 13-foot curve in the lake, securing a channel between the piers 200 feet in width, and not less than 16 feet in depth at extreme low water.

During the year 18,680 cubic yards have been dredged from the channel, and dredging is now in progress.

July 1, 1890, balance unexpended	$24,151.72
Amount appropriated by act approved September 19, 1890	25,000.00
	49,151.72
June 30, 1891, amount expended during fiscal year	14,451.05
July 1, 1891, balance unexpended	34,700.67
July 1, 1891, amount covered by uncompleted contracts	17,982.56
July 1, 1891, balance available	16,718.11
Amount (estimated) required for completion of existing project	134,650.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	75,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix R R 1.)

2. *Pultneyville Harbor, New York.*—The project for the improvement of this harbor was adopted in 1870, the date of the first appropriation, and proposed the construction of a breakwater running eastward from the west shore and then northward into the lake, with an east pier parallel to and about 200 feet from the northerly arm of the west breakwater.

The project was modified in 1875 to provide for increased dredging.

The object of the improvement was to provide a channel of navigable width and not less than 10 feet deep through the bar and into the mouth of Salmon Creek, which was the harbor. The natural channel was not more than 2 feet deep.

The total amount expended to June 30, 1891, is $74,012.29, and has resulted in extension of the piers to the 10 foot curve in the lake.

Shoaling between the piers, however, has reduced the available depth of channel to about 7 feet, while the channel along the shore arm of the west pier, near the mouth of the creek, has shoaled so as to have an available depth of only 3 or 4 feet. This renders it impossible for vessels to approach the wharves and warehouses which are within the mouth of the creek, and thus renders the harbor well-nigh useless, and as a result its commerce has disappeared.

Temporary relief could be afforded by dredging; but as the shoaling is due to wave action the cut would soon be filled up again. The waves when driven by a gale from the northwest strike the east pier in such a way as to be reflected upon the beach at an angle, and in receding they sweep the gravel and shingle into the channel along the shore arm of the west pier. Permanent relief can only be afforded by building a sand-tight structure parallel to the shore arm and between it and the beach, so as to intercept this material and keep it out of the channel. After this is done a dredged cut will remain open. The funds now available will be applied to this purpose; but they will not be sufficient to accomplish the result.

Amount appropriated by act approved September 19, 1890	$2,000.00
June 30, 1891, amount expended during fiscal year	12.29
July 1, 1891, balance unexpended	1,987.71
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 2.)

3. *Harbor at Great Sodus Bay, New York.*—The earliest project for the improvement of this harbor, adopted in 1828, proposed the construction of two breakwaters from east and west shores, approaching to within 500 feet of each other, and connecting at the opening with parallel piers extending into the lake. Subsequent modifications were extensions of the original project, to adjust it to the increased demands of commercé.

The present project was adopted in 1882, the object being to extend the piers to the 15-foot curve in the lake, and dredging a channel between the piers 15 feet deep at low water. The natural channel would admit vessels drawing 8 feet at ordinary lake stage.

The total amount expended from 1829 to June 30, 1891, was $423,886.33, including outstanding liabilities; $4,000 in addition is covered by existing contracts. The amount expended from 1881 to June 30, 1891, was $75,383, including outstanding liabilities. The total expenditure has resulted in the extension of the west pier to the 14-foot curve in the lake, and of the east pier to the 9-foot, with a channel of navigable width and 15 feet deep at low water between them.

The operations of the past year have been renewal of superstructure.

July 1, 1890, balance unexpended	$10,939.54
Amount appropriated by act approved September 19, 1890	10,000.00
	20,939.54
June 30, 1891, amount expended during fiscal year	7,178.99
July 1, 1891, balance unexpended	13,760.55
July 1, 1891, amount covered by uncompleted contracts	4,000.00
July 1, 1891, balance available	9,760.55
Amount (estimated) required for completion of existing project	58,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 3.)

4. *Harbor at Little Sodus Bay, New York.*—The earliest project for the improvement of this harbor was adopted in 1829, and has since been variously modified. The first appropriation was made in 1852. The early project proposed the partial closing of the opening between the bay and lake by lateral dikes connected with two parallel piers extending into the lake.

The present project, which is an expansion of the earlier ones, was adopted in 1881, and is designed to afford a channel of navigable width of not less than 15 feet deep at low water.

The total amount expended from the date of the first appropriation in 1852 to June 30, 1891, is $293.037.95, including outstanding liabilities. The amount expended from the adoption of the present project in 1881 to June 30, 1891, is $58,596.18, including outstanding liabilities. The total expenditure has resulted in the extension of the pier to the

12-foot curve in the lake, securing a channel between the piers of navigable width and 12 feet in depth at extreme low water.

No work was done at this place during the fiscal year.

July 1, 1890, balance unexpended	$5,328.32
Amount appropriated by act approved September 19, 1890	13,000.00
	18,328.32
June 30, 1891, amount expended during fiscal year	374.50
July 1, 1891, balance unexpended	17,953.82
July 1, 1891, amount covered by uncompleted contracts	5,000.00
July 1, 1891, balance available	12,953.82
Amount (estimated) required for completion of existing project	58,500.00
Amount that can be profitably expended in fiscal year ending June 30,1893	40,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 4.)

5. *Oswego Harbor, New York.*—The earliest project for the improvement of this harbor was adopted in 1827, and proposed to inclose an area at the mouth of the river by extending jetties from the shore into the lake, joining the outer ends by a breakwater, but leaving an opening through which to enter the harbor. The project was completed in 1869 and forms the present inner harbor.

The present project was adopted in 1870, and consists of a breakwater 5,800 feet in length parallel to the old west breakwater and 1,100 feet in advance of it. The estimated cost was $1,161,682. It was subsequently modified by the proposed construction of an east breakwater 2,700 feet in length, the reduction to 350 feet of the opening between the east end of the west breakwater and the north end of the light-house pier, the construction of spurs along the face of the outer west breakwater to reduce the effect of accumulated seas, and for deepening by dredging the inner harbor at the mouth of the Oswego River.

The act of August 11, 1888, provided for the removal of the outer east breakwater, of which about 250 linear feet had been built. This has been done, and the construction of an east breakwater may now be regarded as forming no part of the project.

The object of these improvements was to give protection to the city docks and wharves and to the commerce of the harbor and make a depth suitable for the heaviest draft vessels on the lakes.

The natural entrance to the mouth of the river was shallow and difficult of access.

The total amount expended from the date of the first appropriation in 1826 to June 30, 1891, is $1,738.814.80, including outstanding liabilities; $10,000 in addition is covered by existing contract.

The amount expended from the adoption of the present project in 1870 to June 30, 1891, is $1,265,482.07, including outstanding liabilities.

The total expenditure has resulted in the completion of the west breakwater, with the reduction to 350 feet of the opening between the east end of the west breakwater and the north end of the light-house pier; the construction and the removal of 213 linear feet of the east breakwater; the completion of 2 spur cribs, and the deepening of the river mouth to the depth of 15 feet at low water, securing full protection to the docks and wharves west of the river mouth, and channels of entrance 16 feet deep and 350 feet wide each to the inner and outer harbors, and 15 feet deep at low water.

In addition the works have been cared for and maintained, and the perishable portions renewed when necessary since 1829.

Early in December, 1884, a severe northwest storm caused a breach in the west breakwater 140 feet in width, necessitating repairs for a length of 100 feet each side of the breach. This break has not yet been closed, and its existence has been found so advantageous in preserving the purity of the water within the inclosed area by causing a gentle current to flow through it, that a project has been submitted and approved for leaving it open permanently, and to provide shelter from the waves which would enter during storms by additional works.

The operations of the fiscal year have been repairs of damage by storm, and the renewal of the superstructure of 1,300 feet of the outer breakwater.

July 1, 1890, balance unexpended	$65,156.40
Amount appropriated by act approved September 19, 1890	30,000.00
	95,156.40
June 30, 1891, amount expended during fiscal year	66,816.12
July 1, 1891, belance unexpended	28,340.28
July 1, 1891 amount covered by uncompleted contracts	10,000.00
July 1, 1891, balance available	18,340.28
Amount (estimated) required for completion of existing project	125,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix R R 5.)

6. *Harbor at Sacketts Harbor, New York.*—The project for the improvement of this harbor was adopted in 1881, and proposed the deepening of the harbor over an area of about 15 acres to a depth of 12 feet at low water. The depth previously existing was less than 8 feet over a large part of its area.

In 1826 and 1828 the sum of $6,000 was expended in clearing and deepening the harbor.

The total amount expended from 1826 to June 30, 1891, is $14,313.32. The amount expended from the adoption of the present project to June 30, 1891, is $8,313.32, and has resulted in the removal of 24,010 cubic yards of sand, mud, and gravel, and in the construction of a stake and fascine jetty 164 feet in length, with a mooring-crib 18 feet square at its inner end, to shelter the basin and prevent gravel drift into it. With the completion of that work the harbor had a depth of 12 feet at low water over about 6 acres of its area, except in a small part where the presence of rock in place limited the depth to a little less than 12 feet.

July 1, 1890, balance unexpended	$532.76
June 30, 1891, amount expended during fiscal year	28.81
July 1, 1891, balance unexpended	503.95
July 1, 1891, outstanding liabilities	5.00
July 1, 1891, balance available	498.95
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00
Submitted in compliance with requirements of sections 2 of the river and harbor acts of 1866 and 1867.	

(See Appendix R R 6.)

IMPROVEMENT OF SHOAL IN ST. LAWRENCE RIVER, OGDENSBURG HARBOR, AND GRASS RIVER, NEW YORK, AND OF RIVERS AND HARBORS ON LAKE CHAMPLAIN, NEW YORK AND VERMONT.

Officer in charge, Maj. M. B. Adams, Corps of Engineers; Division Engineer, Col. Henry L. Abbot, Corps of Engineers.

1. *Shoal between Sister Islands and Cross-over Light, St. Lawrence River, New York.*—The act of August 11, 1888, provided for a survey of the shoals between Sister Islands and Cross-over Light, in the St. Lawrence River, New York, which being made, was submitted July 2, 1889, and printed in the Report of the Chief of Engineers, 1889, pages 2463 and 2464. The entire improvement was estimated to cost $43,305.

The act of September 19, 1890, appropriated $5,000 for this improvement which has been pledged under contract for the removal of the upper and lower shoals.

Work can be carried on most advantageously in the winter season, when thick ice has formed, but, as the ice did not form of sufficient thickness last winter to bear the machinery, etc., necessary in connection with such operations, the time for completion of the contract has been extended so as to include another winter.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	90.56
July 1, 1891, balance unexpended	4,909.44
July 1, 1891, amount covered by uncompleted contracts	3,952.00
July 1, 1801, balance available	957.44
Amount (estimated) required for completion of existing project	38,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	38,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 1.)

2. *Ogdensburg Harbor, New York.*—The present project for the improvement of this harbor was adopted in 1890, and contemplates the deepening of the various channels leading from the deep water of the St. Lawrence River and that along the city front so as to afford a depth of 17 feet at extreme low water, at an estimated cost of $158,950.

When operations were commenced at this harbor the channels afforded depths from 5 to 12 feet only, and now there are three good channels from deep water in the St. Lawrence River to the nearest docks or wharves, in which water 15 to 16 feet deep is afforded, and a channel 12 to 15 feet deep has been made along the city front. The appropriation of September 19, 1890, has been pledged under contract and will be consumed in widening and deepening the channels at this harbor.

The total amount expended from the date of the first appropriation in 1852 to June 30, 1891, has been $160,874.76, and from the adoption of the project of 1882 to that of 1890, some $40,000 was expended.

July 1, 1890, balance unexpended		$8,418.40
Amount appropriated by act approved September 19, 1890		42,000.00
		50,418.40
June 30, 1891, amount expended during fiscal year		9,287.60
July 1, 1891, balance unexpended		41,130.80
July, 1, 1891, outstanding liabilities	$1,506.11	
July 1, 1891, amount covered by uncompleted contracts	34,418.89	
		35,925.00
July 1, 1891, balance available		5,205.80

Amount (estimated) required for completion of existing project	$80,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	80,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 2.)

3. *Grass River, New York.*—The project for the improvement of this river was adopted in 1881 and has for its object the formation of a channel with a least depth of 4 feet and a least width of 40 feet from the St. Lawrence River to the village of Massena, a distance of about 7½ miles by water. The natural depth of the shoal places is about 2 feet.

The act of August 2, 1882, appropriated $3,000 for this improvement. Work was commenced by dredging at the rapids, September, 1888, and the funds then available ($2,948.60) were consumed with the removal of 1,668½ cubic yards at a cost of $1.76 per yard.

A cut 800 feet long and 26 feet wide was made which lacked 25 feet of carrying it through the shoal, consequently navigation had derived no benefit from the improvement.

The act of September 19, 1890, appropriated $6,000 for this improvement, which was soon placed under contract and has now been consumed in completing the improvement in accordance with the original project.

Amount appropriated by act approved September 19, 1890		$6,000.00
June 30, 1891, amount expended during fiscal year		6,000.00

(See Appendix S S 3.)

4. *Breakwater at Rouse's Point, Lake Champlain, New York.*—The project for this improvement was adopted in 1885, and contemplates the construction of a breakwater composed of rubble and large stone on a straight line from Stony Point until the 18-foot curve in the lake is reached, a total distance of about 2,000 feet.

The estimated cost of the breakwater is $110,000. Work was commenced by contract September, 1885, and has been in progress since then.

Three contracts have been worked out and resulted in the construction of some 1,490 linear feet of completed breakwater.

The appropriation of September 19, 1890, amounting to $15,000, has been placed under contract and will carry the breakwater to about 1,700 feet in length.

The good effects of the breakwater are apparent in the increased shelter afforded at the docks and wharves.

July 1, 1890, balance unexpended		$107.73
Amount appropriated by act approved September 19, 1890		15,000.00
		15,107.73
June 30, 1891, amount expended during fiscal year		7,145.20
		7,962.53
July 1, 1891, balance unexpended	$2,431.21	
July 1, 1891, outstanding liabilities	5,148.38	
		7,579.59
July 1, 1891, amount covered by uncompleted contracts		382.94
July 1, 1891, balance available		15,000.00

Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 4.)

5. *Great Chazy River, New York.*—The act of August 11, 1888, provided for a survey of Great Chazy River, New York, from its mouth on Lake Champlain to Champlain village, which, being made, was submitted July 3, 1889, and printed in the Report of the Chief of Engineers, 1889, page 2466.

The first estimate for the improvement of this stream provided for a least width of 50 feet and a least depth of 6 feet, at a cost of $34,000, afterwards reduced to a channel 40 feet wide and 5 feet deep at a cost of $18,000.

The act of September 19, 1890, appropriated $10,000 for this improvement, which has been placed under contract.

Operations have been commenced and are to be completed this season.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		44.41
July 1, 1891, balance unexpended		9,955.59
July 1, 1891, outstanding liabilities	$1,427.03	
July 1, 1891, amount covered by uncompleted contracts	7,706.97	
		9,134.00
July 1, 1891, balance available		821.59
Amount (estimated) required for completion of existing project		8,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		8,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix S S 5.)

6. *Breakwater at Gordon Landing, Lake Champlain, Vermont.*—The project for this improvement was adopted in 1887, and has for its object the construction of a stone breakwater, composed of rubble and large stones extending in a straight line to the 16-foot curve in the lake for the purpose of affording increased shelter to a landing on the west shore of Grand Isle, Lake Champlain, Vermont.

Construction commenced August 11, 1887, and has been in progress under contract since then. The structure is to be terminated at 675 feet in length instead of 800 feet as originally contemplated, and is now completed with the exception of the facing of large stones and rubble stone core for about 135 feet at its outer end.

The appropriation of September 19, 1890, $6,000, has been pledged under contract, operations are soon to be commenced, and the improvement is to be completed this season in accordance with the modified project.

Amount appropriated by act approved September 19, 1890	$6,000.00
June 30, 1891, amount expended during fiscal year	43.95
July 1, 1891, balance unexpended	5,956.05
July 1, 1891, amount covered by uncompleted contracts	5,333.20
July 1, 1891, balance available	622.85

(See Appendix S S 6.)

7. *Plattsburg Harbor, New York.*—The first appropriation for the improvement of this harbor was in 1836.

The project then adopted and the modifications that have been made since have resulted in the construction of 1,250 linear feet of breakwater, the protection of a portion of the beach, and the dredging of some shoal areas within the harbor.

Under the appropriation of September 19, 1890, amounting to $32,500, proposals were invited and a contract made for repairing the superstructure of the existing breakwater and for prolonging it 300 feet northward.

Operations are in progress, but the contract does not require completion until November, 1892.

The total amount expended at this harbor to June 30, 1891, has been $154,559.76, of which amount $66,379.75 was expended since the adoption of the modified project of 1870.

July 1, 1890, balance unexpended		$2,391.19
Amount appropriated by act approved September 19, 1890		32,500.00
		34,891.19
June 30, 1891, amount expended during fiscal year		3,770.94
July 1, 1891, balance unexpended		31,120.25
July 1, 1891, outstanding liabilities	$2,892.20	
July 1, 1891, amount covered by uncompleted contracts	23,647.92	
		26,540.12
July 1, 1891, balance available		4,580.13

(See Appendix S S 7.)

8. *Burlington Harbor, Vermont.*—This improvement dates from 1836. Modifications of the original plan have been made from time to time so as to afford adequate protection to the increasing commercial and shipping interests of the harbor. The last modification, made in 1886, provides for further extension of the breakwater, both to the north and to the south, with its gradual withdrawal as it is prolonged into water about 30 feet deep, instead of 38 feet deep, so as to reduce the cost.

Operations during the past year consisted in the completion of the 360 feet northward extension to the breakwater, then under contract, and in some slight repairs.

The appropriation of September 19, 1890, $20,000, will be expended in repairs as needed. The total amount expended to date has been $562,390.58, and under the existing project $55,808.46.

July 1, 1890, balance unexpended	$9,987.41
Amount appropriated by act approved September 19, 1890	20,000.00
	29,987.41
June 30, 1891, amount expended during fiscal year	10,455.79
July 1, 1891, balance unexpended	19,531.62
Amount (estimated) required for completion of existing project	129,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 8.)

9. *Otter Creek, Vermont.*—The project for this improvement proposes the formation of a channel of navigable width and a least depth of 8 feet from Vergennes, Vt., to Lake Champlain.

The appropriation of September 19, 1890, $5,000, has been pledged under contract for the removal by dredging of 21,000 cubic yards from such shoals as most require deepening.

Operations are to be commenced and completed this season, and will practically consume the available funds.

There has been expended to June 30, 1891, $36,520.83. The stream

only requires a little more widening and deepening to carry out the original scheme for improvement, but, unfortunately, the channel afforded is not likely to prove permanent.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	20.83
July 1, 1891, balance unexpended	4,979.17
July 1, 1891, amount covered by uncompleted contracts	4,200.00
July 1, 1891, balance available	779.17
Amount (estimated) required for completion of existing project	10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 9.)

10. *Ticonderoga River, New York.*—The project for this improvement was adopted in 1881, its object being to afford a channel of navigable width and a least depth of 8 feet at low water from Ticonderoga village to Lake Champlain, a distance of about 2 miles. The original estimated cost of the improvement was $42,516, and the amount expended has resulted in an improved channel.

The appropriation of September 19, 1890, $2,000, has been pledged under contract, and operations are to be commenced and completed this season that will consume the available funds.

Amount appropriated by act approved September 19, 1890	$2,000.00
June 30, 1891, amount expended during fiscal year	22.25
July 1, 1891, balance unexpended	1,977.75
July 1, 1891, amount covered by uncompleted contracts	1,785.00
July 1, 1891, balance available	192.75
Amount (estimated) required for completion of existing project	26,016.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 10.)

11. *Narrows of Lake Champlain, New York and Vermont.*—The project for this improvement was adopted in 1885, and has for its object the removal of such obstructions in the channel as will afford a least depth of 12 feet, and a least width of 150 feet from Whitehall to the Elbow, and 12 feet depth and 200 feet width along Cedar Mountain and across Kenyon Bay.

The entire undertaking was estimated to cost $80,000; $45,000 had been appropriated and the original project stood completed a year ago at a little more than half the estimated cost.

The officer in charge recommends the improvement of three locations between the Elbow and Cedar Mountain by dredging, and at an estimated cost of $21,000.

July 1, 1890, balance unexpended	$2,939.37
June 30, 1891, amount expended during fiscal year	270.50
July 1, 1891, balance unexpended	2,668.87
Amount (estimated) required for completion of existing project	18,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	18,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix S S 11.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major M. B. Adams, and reports thereon submitted through Col. Henry L. Abbot, Corps of Engineers, Division Engineer, Northeast Division. It is the opinion of Major Adams, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Inner Bay near mouth of Saranac River at Plattsburg, New York, for harbor of refuge.*—Printed as House Ex. Doc. No. 22. (See also Appendix S S 12.)

2. *Boquet River, New York, from mouth on Lake Champlain to Willsboro.*—Printed as House Ex. Doc. No. 30. (See also Appendix S S 13.)

PACIFIC COAST.

IMPROVEMENT OF OAKLAND HARBOR, AND SURVEY OF SAN FRANCISCO HARBOR AND ADJACENT WATERS, CALIFORNIA.

Officer in charge, Col. G. H. Mendell, Corps of Engineers, having under his immediate orders Lieut. H. C. Newcomer, Corps of Engineers, the entire year, and Lieut. Charles L. Potter, Corps of Engineers, since June 18, 1891.

1. *Oakland Harbor, California.*—The principal features of this improvement as originally projected are two jetties of rubblestone extended from the shore westward into the Bay of San Francisco to about 14 feet depth at low water, a connection by canal 1½ miles in length of the adjoining estuary of San Leandro with the basin of the harbor, dredging of the basins and channels to give 20 feet at mean low water, with the additional depth due to tide. The channel when finished will carry vessels of the largest commercial drafts.

Later modifications of the project consist in increasing width of canal from 300 to 400 feet, in raising the jetties originally for half tide to height of full high water, and in dredging to a greater extent. The depth at beginning of project was about 2 feet at low tide, admitting vessels of 6 to 8 feet draft at high water. The present depth at mean low water is 14 feet, and vessels drawing 18 feet and even more now can enter.

The channel from the Bay of San Francisco to city of Oakland is for most of its length 300 feet in width and nowhere less than 225 feet, and is in every respect convenient for vessels.

Operations of the past year consisted in excavating a part of the tidal canal 471,155 cubic yards, in dredging channel in front of Oakland 62,048 cubic yards, in beginning the construction of a steel highway bridge at Park street, Alameda, and in stone work on the jetties.

Three-fourths of the excavation for the foundations of bridge piers was executed and a beginning of placing the masonry was made. The bridge is to be opened on November 1. The only work done during the past year which was immediate in increasing commercial facilities was widening the 14-foot channel in front of Oakland from 100 to 225 feet. The increased convenience of this channel is at least in part to be cred-

ited with promised extension of traffic due to larger enterprise now in progress, and also with a portion of the increase of trade shown in the table of statistics.

The amount expended upon this harbor on June 30, 1891, was $1,287,333.21.

The available balance on hand is to be applied during the present season to improving the channel in front of Oakland. The next appropriation is to be applied to the tidal canal, to completion of jetties, and improvement of channels.

July 1, 1890, balance unexpended		$115,912.31
Amount appropriated by act approved September 19, 1890		250,000.00
		365,912.31
June 30, 1891, amount expended during fiscal year		118,645.52
July 1, 1891, balance unexpended		247,266.79
July 1, 1891, outstanding liabilities	$546.66	
July 1, 1891, amount covered by uncompleted contracts	181,133.72	
		181,680.38
July 1, 1891, balance available		65,586.41
Amount (estimated) required for completion of existing project		991,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix T T 1.)

2. *Survey of San Francisco Harbor, San Pablo and Suisun bays, Strait of Carquinez, and mouths of San Joaquin and Sacramento rivers, California.*—Harbor lines for Port Costa, Benicia, and Vallejo were recommended and approved by the War Department. Subsequently a slight modification extending the pier-head line 15 feet in from a wharf at Port Costa was recommended and approved.

The project includes surveys of bays as named. About 110 square miles of San Francisco Bay were included in a hydrographic survey made in 1887–'88. Sixteen thousand dollars are required to sound 100 square miles, including the bar and entrance.

July 1, 1890, balance unexpended	$1,128.39
June 30, 1891, amount expended during fiscal year	75.00
July 1, 1891, balance unexpended	1,053.39
Amount (estimated) required for completion of existing project	16,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	16,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix T T 2.)

IMPROVEMENT OF NAPA RIVER, REDWOOD HARBOR AND CREEK, AND SAN LUIS OBISPO, WILMINGTON, AND SAN DIEGO HARBORS, CALIFORNIA.

Officer in charge, Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, with Lieut. James J. Meyler, Corps of Engineers, under his immediate orders.

1. *Napa River, California.*—In charge of Col. G. H. Mendell, Corps of Engineers, to November 21, 1890. The project is to clear the river of snags and the banks of overhanging trees interfering with navigation

and to dredge the bars and projecting points of land so as to give a depth of 4 feet at low water.

Work was commenced in 1889. The river was cleared of snags and a gravel bar near the steamboat landing was dredged.

A contract was entered into March 12 last with Thomas H. Williams, jr., to remove certain snags and to dredge about 16,000 cubic yards of material, so as to provide a navigable channel of the desired depth through the worst bars. Work was commenced late in June, and at the close of the year 729 cubic yards of material had been removed from the channel at Carr's Point. The entire work contracted for will be completed by the end of August. This will leave the river in fair boating condition and complete the present project. No additional appropriations are therefore asked. Work will be needed in the future, as the bars will re-form from material brought down during the winter storms.

The total amount appropriated for this improvement is $17,500 and the total amount expended is $5,280.80.

July 1, 1890, balance unexpended		$3,114.55
Amount appropriated by act approved September 19, 1890		10,000.00
		13,114.55
June 30, 1891, amount expended during fiscal year		895.35
July 1, 1891, balance unexpended		12,219.20
July 1, 1891, outstanding liabilities	$298.94	
July 1, 1891, amount covered by uncompleted contracts	7,736.16	
		8,035.00
July 1, 1891, balance available		4,184.20

(See Appendix U U 1.)

2. *Redwood Harbor, California.*—This work is now being continued under an appropriation made for improving Redwood Creek. No operations were carried on during the year.

July 1, 1890, balance unexpended	$2.30
June 30, 1891, amount expended during fiscal year	2.30

(See Appendix U U 2.)

3. *Redwood Creek, California.*—In charge of Col. G. H. Mendell, Corps of Engineers, from September 20 to November 21, 1890. This improvement is a continuance of that heretofore carried on under appropriations made for Redwood Harbor. The project for this latter work embraced the dredging of the creek so as to give a channel 50 feet wide and 3 feet deep at mean low tide for a stretch of about 6,000 feet in the vicinity of the town of Redwood. The work was completed in 1889. It was considered that the improvement would not be of a permanent character, as there would be a constant tendency to shoaling, due to natural causes. An examination made in 1890 showed that the dredged channel had partially filled up. The appropriation of $8,000 made by the river and harbor act of September 19, 1890, was for the purpose of redredging the stretch in question and for opening a channel through the middle ground.

The estimates upon which the appropriation was made contemplated using the Government dredge, as heretofore, in carrying on the proposed work. The officer in charge states that the dredge has been in service on the San Joaquin River, to which improvement it belongs, and that he has therefore been unable to work with it at Redwood. It is expected to commence work at the latter place early in the fall and complete the dredging during the winter. As this will complete the present project no additional appropriations are asked.

For improving Redwood Harbor the amount of $15,400 has been appropriated and expended.

The amount appropriated for Redwood Creek is $8,000. Nothing has been expended.

Amount appropriated by act approved September 19, 1890	$8,000
July 1, 1891, balance unexpended	8,000

(See Appendix U U 3.)

4. *San Luis Obispo Harbor, California.*—The project for this improvement is intended to secure a protected anchorage and landing at Port Harford by the construction of a breakwater on Whaler Reef extending from Point San Luis to Whaler Island, and thence to a point where the outer reef rises above high water. The total length of the structure when completed will be about 2,300 feet.

That portion of the breakwater between Point San Luis and Whaler Island is completed, and a commencement has been made upon the extension beyond the island.

A contract was entered into January 20 last with the San Francisco Bridge Company to deliver and place in position upon the outer reef about 11,000 tons of rock.

The Light House Board having granted permission to take material from the reservation at Morro Rock, the contractor is engaged in running a tunnel so that all the material required to fill the contract can be blasted at one time. The work of depositing the material in place upon the line of the breakwater will be commenced in July, and the work contracted for will be completed before December.

Work will be continued in the future upon the other extension of the breakwater.

The amount of $125,000 asked for the fiscal year ending June 30, 1893, is for a continuance of these operations.

The total amount appropriated for the improvement is $65,000, and the total amount expended is $25,917.44.

July 1, 1890, balance unexpended		$9.30
Amount appropriated by act approved September 19, 1890		40,000.00
		40,009.30
June 30, 1891, amount expended during fiscal year		926.74
July 1, 1891, balance unexpended		39,082.56
July 1, 1891, outstanding liabilities	$7.00	
July 1, 1891, amount covered by uncompleted contracts	36,000.00	
		36,007.00
July 1, 1891, balance available		3,075.56
Amount (estimated) required for completion of existing project		219,900.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		125,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix U U 4.)

5. *Wilmington Harbor, California.*—Previous to the commencement of the improvement in 1871 there was a depth not to exceed 1 foot at the entrance at low tide. In 1881 this depth had been increased to 10 feet. The present project, which was adopted on that year, is intended to secure a depth of 16 feet at mean low water. That depth has been obtained through the channel from the railroad wharf to Deadman Island. In the channel along the island, and at the entrance, the least depth is 13.5 feet—a gain of 1.5 feet during the last year. It is intended to still increase this depth by dredging and by extending the jetties.

During the past year, operations have consisted in making needed repairs to the timber work of the east jetty; dredging a channel 300 feet wide to a depth of 16 feet at mean low water from the railroad wharf to Deadman Island, and in raising and extending the jetties. Sixty-two thousand two hundred and ninety-five and forty-six hundreths cubic yards of material were dredged from the inner channel, and deposited in San Pedro Bay. Contracts were entered into for the delivery of 33,000 tons of rock for the jetties. At the close of the year the contractors had delivered 15,123.47 tons of material, which was used in building up the west jetty to its full height at various points and upon its extension seaward.

The work of dredging and of jetty extension will be carried on during the coming season, and in the future under the existing project to the extent of the funds made available.

The amount estimated to complete existing project is $51,000.

The total appropriated is		$904,000.00
The total expended is		823.682.10
July 1, 1890, balance unexpended		123,244.46
Amount appropriated by act approved September 19, 1890		34,000.00
		157,244.46
June 30, 1891, amount expended during fiscal year		71,676.28
July 1, 1891, balance unexpended		85,568.18
July 1, 1891, outstanding liabilities	$10,698.41	
July 1, 1891, amount covered by uncompleted contracts	52,674.48	
		63,372.89
July 1, 1891, balance available		22,195.29
Amount (estimated) required for completion of existing project		51,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		51,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

(See Appendix U U 5.)

6. *San Diego Harbor, California.*—The work heretofore carried on at San Diego had for its object the preservation of the harbor which was being injured by the deposition of material brought down by the San Diego River in flood stages. The river was diverted from its course and caused to empty into False Bay. This was accomplished by building a substantial levee across the old channel of the river near its entrance to the harbor and excavating a new water way leading to False Bay. This work was completed in 1876, since which time operations have consisted simply in keeping the levee in good condition. The total amount expended upon the work to the close of the fiscal year, including a small amount from the present appropriation, is $82,085.37.

The dredging at the head of the middle ground, so as to provide a channel at that point 500 feet wide and 24 feet deep at mean low water, was commenced in April. At the close of the fiscal year 4,220 cubic yards of sand had been dredged, providing a channel 150 feet wide. Dredging will be continued to the extent of the available funds. It is expected that the channel will be completed by the end of August.

The approved project for securing a depth of 26 feet at mean low tide over the bar contemplates the construction of a jetty of brush and stone 7,500 feet in length, extending from the south shore of Coronado North Island out on Zuninga Shoals. Before commencing operations the title to the land at the root of the jetty must be acquired by the United States. As the parties owning the land have declined to sell

the tract desired, condemnation proceedings will be undertaken to secure the tract for the Government. When this is accomplished the construction of the jetty will be commenced.

The amount appropriated for dredging is $8,000 and the amount expended, including outstanding liabilities, is $1,967.47.

The amount appropriated for jetty on Zuninga Shoal is $52,000, and the amount expended is $85.00.

The amount asked for the fiscal year ending June 30, 1893, is for a continuance of work upon the jetty and for the care of the levee at Old Town.

July 1, 1890, balance unexpended	$31.55
Amount appropriated by act approved September 19, 1890	60,500.00
	60,531.55
June 30, 1891, amount expended during fiscal year	2,019.39
July 1, 1891, balance unexpended	58,512.16
July 1, 1891, outstanding liabilities	1,456.05
July 1, 1891, balance available	57,056.11
Amount (estimated) required for completion of existing project	334,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	201,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix U U 6.)

EXAMINATIONS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Lieutenant-Colonel Benyaurd, and reports thereon submitted. It is the opinion of Lieutenant-Colonel Benyaurd, based upon the facts and reasons given, that these localities are not worthy of improvement. This opinion being concurred in by me, no further surveys were ordered.

1. *San Rafael River, California.*—Report transmitted to Congress, and printed as House Ex. Doc. No. 54, Fifty-first Congress, second session. (See also Appendix U U 7.)

2. *Alviso Harbor, and straightening, deepening, and improving of Alviso Creek, California.*—Report transmitted to Congress, and printed as House Ex. Doc. No. 16, Fifty-first Congress, second session. (See also Appendix U U 8.)

3. *Improving and straightening Redwood Creek, California.*—Report transmitted to Congress, and printed as House Ex. Doc. No. 55, Fifty-first Congress, second session. (See also Appendix U U 9.)

4. *Harbor of refuge at Santa Cruz, California.*—Report transmitted to Congress, and printed as House Ex. Doc. No. 32, Fifty-first Congress, second session. (See also Appendix U U 10.)

5. *San Simeon Bay, California.*—Report transmitted to Congress, and printed as House Ex. Doc. No. 64, Fifty-first Congress, second session. (See also Appendix U U 11.)

6. *Redondo Beach Harbor, California.*—(See Appendix U U 12.)

7. *Colorado River, Arizona, above Yuma, to Eldorado Canyon, to determine the advisability and probable cost of improving said river.*—Report transmitted to Congress, and printed as House Ex. Doc. No. 18, Fifty-first Congress, second session. (See also Appendix U U 13.)

EXAMINATION FOR DEEP-WATER HARBOR ON THE PACIFIC COAST BETWEEN POINTS DUMA AND CAPISTRANO, CALIFORNIA, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

In compliance with the provisions of the act of September 19, 1890, a Board of Engineers, consisting of Col. G. H. Mendell and Lieut. Cols. G. L. Gillespie and W. H. H. Benyuard, Corps of Engineers, was constituted "to examine the Pacific coast between Points Duma and Capistrano with a view to determining the best location for a deep-water harbor," and to report a project and estimate of cost for the same. The report of the Board will be submitted when received.

IMPROVEMEMT OF SAN JOAQUIN, MOKELUMNE, SACRAMENTO AND FEATHER RIVERS, PETALUMA CREEK, AND HUMBOLDT HARBOR AND BAY, CALIFORNIA.

Officer in charge, Maj. W. H. Heuer, Corps of Engineers; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *San Joaquin River, California.*—This river before improvement began had a 6-feet deep low-water channel less than 100 feet wide to Stockton, and a channel less than 2 feet in depth, for a few months annually, on the upper river to Hill's Ferry.

The project adopted in 1877 had for its object the securing and maintaining, by dredging, of a channel 100 feet wide and 9 feet deep to Stockton, and the making of cut-offs, and the general temporary improvement of the upper river by wing dams, snagging, and the partial or complete closure of some of the outlets.

The project as adopted has been carried on continuously whenever funds permitted, and as a result the time of annual navigation on the upper reaches of the river has been prolonged, and a 9-foot channel maintained to Stockton by dredging.

Without this annual dredging navigation to Stockton would soon be closed, as the channel in Stockton Slough is not and can not be made self maintaining.

At the close of the last fiscal year the river was so high that its real condition could not be ascertained, but it was believed that the unusual floods had refilled the Stockton Channel to a great extent, and also carried away a considerable portion of the submerged dam at Paradise Cut. This was found to be true, and from the middle of October, 1890, to the middle of May, 1891, dredging was carried on continuously, Stockton Slough being again dredged to a 9-foot depth at low water, and two sand bars being removed from the main river. This enabled navigation to Stockton to be carried on uninterruptedly the whole year. This dredging required the removal of 138,242 cubic yards of material in cuts aggregating 16,374 feet long, each cut being made 50 feet wide. This work was done at an average cost of $10\frac{1}{4}$ cents per cubic yard.

During May and June, 1891, contracts were made to rebuild the dam at Paradise Cut, which was destroyed by the excessive floods of the spring of 1890, and build a dam at Laird Slough. A contract has also been let to make a cut-off at Head Reach. At the end of the fiscal year operations were being commenced on all three of these works.

Up to the end of the fiscal year ending June 30, 1890, $180,330.49 had been spent on this river; during the present fiscal year an additional $15,490.01 has been spent. The expenditure of this money has enabled

navigation to Stockton to be carried on continuously without interruption or delay.

The navigation of this river is carried on 10 steamboats, the largest having a gross tonnage of 880 tons, and 14 barges with an average tonnage of 300 tons.

Dredging will be again required in Stockton Slough to maintain navigation, and snagging and wing-dam building or small cut-offs may be required in the upper river. The cut at Head Reach will require to be enlarged and another cut-off should be made at Twenty-one Mile Slough. All this can be done in one fiscal year.

As owners of land where cut-off was to be made demanded an exorbitant price for it, which we did not pay, the navigation company and a few public-spirited citizens bought the right of way over the proposed line of cut and deeded it free of expense to the Government. Should any money be appropriated for making the cut-off at Twenty-one Mile Slough, it is recommended that it be with the proviso that none of the money for making the cut-off shall be expended until the right of way on the line of the cut-off shall be deeded to the United States Government free of expense.

July 1, 1890, balance unexpended	$3,496.54
Amount appropriated by act approved September 19, 1890	75,000.00
	78,496.54
June 30, 1891, amount expended during fiscal year	15,494.01
July 1, 1891, balance unexpended	63,002.35
July 1, 1891, amount covered by uncompleted contracts	37,800.00
July 1, 1891, balance available	25,202.53
Amount (estimated) required for completion of existing project	136,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	136,750.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V V 1.)

2. *Mokelumne River, California.*—Before improvement began on this river in 1884 it was obstructed by snags and overhanging trees, causing delay and danger to navigation, and the project adopted aimed at the removal of these obstacles. There has been appropriated $13,000, of which $12,457.62 has been spent, and in 1884, 1885, 1886, 1887, and 1888 all obstructions were removed and the project completed leaving the river in good navigable condition. No work has been done in the last fiscal year, but an examination was made which showed obstructions in the shape of a sharp point of land and a shoal caused by a drainage canal, dug by private parties, which are a great and increasing injury to the navigation of the river. Snags will also again lodge in the river and overhanging trees will again require removal. To remove these obstructions and again clear the river of trees and snags it is estimated will cost $9,100. It is not believed that the improvements have caused any reduction in the rates of freight or insurance, but the rate of freight by steamer is $1 less than by rail from competing points, thus effecting a large saving in freight annually. One steamer, the *Constance*, makes three round trips and carries all the freight offering.

July 1, 1890, balance unexpended	$560.30
June 30, 1891, amount expended during fiscal year	17.92
July 1, 1891, balance unexpended	542.38

Amount that can be profitably expended in fiscal year ending June 30, 1893	$9,100.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V V 2.)

3. *Sacramento and Feather rivers, California.*—Before improvement began on these rivers navigation was dangerous on account of snags, besides which, on the upper Sacramento River and Feather River, there were numerous shoals which were obstructions to navigation.

In 1874 a project was made for the improvement of their low-water channels, to consist of the removal of snags, scraping of bars, and the building of temporary wing dams for concentrating the currents and reducing widths where required. Since that time work has been continuous on this project when funds permitted.

Up to June 30, 1890, there had been spent on the improvement of these rivers $390,588.53, and during the present fiscal year a further sum of $78,246.02 has been expended.

At the end of the last fiscal year the rivers were in a fair navigable condition, the closure of the crevasse just opposite the city of Sacramento being about completed at a cost of $69,148.07. The county of Yolo built a substantial levee behind the works.

The river fell shortly afterwards and on August 1 the snag boat was put to work in the upper Sacramento River. By October 22, 855 snags had been removed, leaving a good and safe channel to the head of navigation, and the boat was again laid up.

Late in October, 1890, the channel of the Feather River was found to be deteriorating from sand bars formed in consequence of crevasses in the levees. A contract to repair the levees was accordingly made and these crevasses, aggregating 479 feet in length, were closed by the end of November, 1890, at a cost of $4,018.23.

Near the close of the present fiscal year the snag boat was again put in commission and is now at work in the upper Sacramento River.

In consequence of the improvements made there has been no interruption to navigation during the past fiscal year, there having been no less than 6 feet depth in the lower river. Snags will reform with each annual high stage of the river and operations to remove them must be carried on each year. If this is not done navigation in the upper Sacramento River must cease during the low-water stage, and it is during this stage that the heaviest freighting is done, as the wheat crop is then being moved from the Sacramento Valley. The upper river had during the present year a least depth of 30 inches of water.

The commerce of the Sacramento River is carried on 8 steamboats and 21 barges belonging to the Sacramento Transportation Company, 2 steamers belonging to the Southern Pacific Company, and 5 steamers and 7 barges of the California Transportation Company. Only the steamers and barges of the Sacramento Transportation Company run above Sacramento.

On the Feather River only one steamboat is run, making one round trip per week. It is owned by the Southern Pacific Company.

In compliance with the provisions of the river and harbor act approved September 19, 1890, a Board of Engineers, consisting of Col. G. H. Mendell, Maj. A. Mackenzie, and Capt. Dan. C. Kingman, Corps of Engineers, was constituted by authority of the Secretary of War to consider Sacramento and Feather rivers, California, with a view to project for future improvement. The report of the Board was submitted under date of February 3, 1891, and was transmitted to Con-

gress and printed as House Ex. Doc. No. 246, Fifty-first Congress, second session.

July 1, 1890, balance unexpended	$74,411.47
Amount appropriated by act approved September 19, 1890	30,000.00
	104,411.47
June 30, 1891, amount expended during fiscal year	78,246.02
July 1, 1891, balance unexpended	26,165.45
July 1, 1891, outstanding liabilities	1.447.85
July 1, 1891, balance available	24,717.60

Amount that can be profitably expended in fiscal year ending June 30, 1893 420,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix V V 3.)

4. *Petaluma Creek, California.*—Before improvement this creek was crooked and, in places at low water, bare. In 1880 a project was made and adopted for improving it by making cutoffs and dredging a channel 50 feet wide and 3 feet deep at low-water stage. Work was done by contract, and in 1884 the project was completed at a cost of $27,656.91. In 1888, the channel having deteriorated was again dredged to a depth of 1 foot below low water, at a cost of $2,116.39. The channel having again refilled, bids were invited and a contract made in June, 1891, to redredge it. This work, which will again relieve the immediate wants of navigation, will be commenced at once and leave the creek in fair steamboating condition, but, as the channel is not self-maintaining, redredging will be necessary every few years. Without occasional dredging navigation on this creek would soon be entirely stopped. One steamboat, 294 tons, makes daily trips between Petaluma and San Francisco, and schooners run as regularly as wind and weather permit.

July 1, 1890, balance unexpended	$2,016.46
Amount appropriated by act approved September 19, 1890	4,000.00
	6,016.46
June 30, 1891, amount expended during fiscal year	63.05
July 1, 1891, balance unexpended	5,953.41
July 1, 1891, amount covered by uncompleted contracts	5,953.41

Amount (estimated) required for completion of existing project 30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix V V 4.)

5. *Humboldt Harbor and Bay, California.*—Prior to commencing work in 1881 the channels in Humboldt Bay were shallow, and vessels sometimes had difficulty in getting to wharves in Eureka, Arcata, and Hookton. They were dredged out, a depth of 13 feet at low water was obtained to Eureka wharves, and channels having 10 feet in depth at low water were dredged to Arcata and Hookton. This was the project which was originally adopted, and which was completed in 1884.

In 1882 a project was adopted for building a low training wall so as to improve the entrance to Humboldt Bay. This wall was to be about 6,000 feet long and to extend from the south spit in a northwest direction out towards the bar.

Up to June 30, 1890, $196,927.47 had been spent on the improvement

of Humboldt Harbor and Bay; of this sum $96,061.55 had been spent on the completed project of dredging the channels in the bay, and $100,865.92 on the improvement of the entrance. At that time the jetty had been extended from the south spit 3,327 linear feet, but was as yet in too incomplete a condition to have any material effect on the channel. The contractor was still at work on it, but was delivering stone in a slow and uncertain way, and by October 31 had only delivered an additional quantity of 10,777 tons. This left a balance of 41,649 tons to be delivered to complete the contract. The contractor failed to deliver this, ceased work, and his contract was annulled.

In October, 1890, a Board of Engineers was convened to consider and report upon a project for the improvement of Humboldt Bay. The Board met at Eureka on December 11, 1890. After study of the subject it was decided to modify the existing project to embrace shore protection work on the north spit, and the construction of another jetty starting from the north spit, extending seaward a little less than 7,000 feet and leaving an open entrance at the outer end, both jetties to extend out to the 18 feet contour and be raised to the plane of high water. The cost of completing this project, in addition to the sums already appropriated, was estimated to be $1,715,115. This modification of the project was approved.

The old contract being annulled, fresh bids for the work were invited and a new contract made on February 7, 1891. By May 5, the contractors commenced delivering stone into the jetty on the south spit and up to June 30, 1891, had delivered 8,169 tons. Owing to the erosion of the north spit, preparations were made during the month of June to build protection work on that spit, and at the end of the fiscal year a wharf and approaches had been built, track had been laid, and all was readiness to begin actual protection work. The object of this protection work, which is to consist of brush mattress work covered with rock, is to prevent further erosion of the north spit, also to narrow the entrance somewhat, and to remove a shoal which has formed just to the eastward of the entrance.

The operations of this fiscal year have raised the south jetty to 6 feet above low water for the first 1,800 feet, and to from low water to 2 feet below on the outer 1,200 feet of the jetty.

It is not known that the work thus far done has materially increased the depth of water on the bar, nor was it as yet expected to, but it has caused the south spit to grow seaward, thus forming a more direct channel and insuring the stability of the work.

The commerce of Humboldt Bay is carried by two steamers running regularly between San Francisco and Eureka, each making two trips per week, also several steam schooners and numerous sailing vessels, engaged principally in the lumber trade.

July 1, 1890, balance unexpended		$145,572.78
Amount appropriated by act approved September 19, 1890		80,000.00
		225,572.78
June 30, 1891, amount expended during fiscal year		41,047.33
July 1, 1891, balance unexpended		184,525.45
July 1, 1891, outstanding liabilities	$480.00	
July 1, 1891, amount covered by uncompleted contracts	152,027.50	
		152,507.50
July 1, 1891, balance available		32,017.95

Amount (estimated) required for completion of existing project	$1,715,115.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	700,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix V V 5.)

EXAMINATION AND SURVEY FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examination of *Mokelumne River, California, for snagging*, was made by the local engineer in charge, Major Heuer, and report thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Major Heuer, and of the Division Engineer, based upon the facts and reasons given, that this river is worthy of improvement as stated. This opinion being concurred in by me, Major Heuer was charged with and has completed its survey and submitted report thereon. No snagging is at present required on this river, but certain improvements are needed at obstructions which exist in the vicinity of Snodgrass Slough and New Hope Landing. The cost of this work is estimated at $7,100. The reports were transmitted to Congress and printed as House Ex. Doc. No. 178, Fifty-first Congress, second session. (See also Appendix V V 6.)

INVESTIGATION OF MINING-DÉBRIS QUESTION IN STATE OF CALIFORNIA, TO COMPLY WITH REQUIREMENTS OF ACT APPROVED OCTOBER 1, 1888.

In compliance with the provisions of the act of October 1, 1888, a Board of Engineers, consisting of Lieut. Col. W. H. H. Benyaurd, Maj. W. H. Heuer, and Maj. Thomas H. Handbury, Corps of Engineers, was constituted by the Secretary of War—

> For the purpose of making a thorough examination and investigation of the mining débris question in the State of California, for the purpose of ascertaining whether some plan can be devised whereby the present conflict between the mining and farming sections may be adjusted and the mining industry rehabilitated, and for a complete examination of the injured navigable river channels, their tributaries and lands adjacent thereto, with a view to the improvement and rectification of said rivers.

The report of the Board was submitted under date of February 9, 1891, was transmitted to Congress and printed as House Ex. Doc. No. 267, Fifty-first Congress, second session, and is now presented with the annual report of the officer in charge upon the improvement of Sacramento and Feather rivers, California. (See Appendix V V 3.)

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN OREGON AND WASHINGTON.

Officer in charge, Capt. Thomas W. Symons, Corps of Engineers, with Lieut. Graham D. Fitch, Corps of Engineers, under his immediate orders since March 6, 1891; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Coquille River, Oregon.*—At the time the work of improvement was begun, the entrance to the Coquille River was considered very dangerous. It was by a long, tortuous, and narrow channel skirting the south headland, and studded with rocks from beyond the bar on the outside,

to a distance of one-half mile inside. The depth at low water was only about 3 feet, and the position of the channel was constantly shifting.

The channel sometimes at long intervals apart broke through the north spit, and ran directly out to sea just south of Rackliffe Rock. The entrance was then comparatively safe, and the channel at its best, but soon shifted. The mean rise of tide was 4.1 feet.

The plan of improvement is to construct two parallel high-tide jetties 600 feet apart, running out to sea far enough to open and maintain an 8-foot low-water channel over the bar; the north jetty starting from Rackliffe Rock, the south jetty from a point inside the entrance on the left bank. The cost of this work, as estimated in 1878 by Maj. J. M. Wilson, is $164,000. The law of August, 1888, authorized in addition $5,000 to be expended for snagging, and the law of September 19, 1890, $3,000.

Amount expended to June 30, 1890, was $74,848.48, in which is included $4,000 used for snagging.

The results obtained to June 30, 1890, were highly satisfactory, there being then a straight channel out to sea with a depth of 10 feet at low water. From the outer end of the jetty a deposit of sand had formed a well-defined training wall in prolongation of the jetty, and on the north side, parallel with the jetty, a similar low sand training wall had been deposited; thus the ebbing and flowing tides and river waters were directed in a straighter and deeper channel over the bar to sea. This result was hastened by the removal of a dangerous mid-channel rock just inside the entrance; the citizens contributing the necessary labor, powder, and other material, as the appropriation had been exhausted, and this office supplying only the blasting machine and skilled supervisor.

The snagging between Coquille City and Myrtle Point was of great benefit to navigation.

Amount expended during the fiscal year ending June 30, 1891, was $9,048.03. The very satisfactory conditions prevalent a year ago have not been maintained. Winds and currents have at times heaped the movable sands into the channel, causing it to break away to the northward, shallow in depth and bad in direction. To remedy this it was decided to abandon work for the present on the south side, and to use the present appropriation in building the north jetty as far out as the funds available would permit.

During the year the river was effectually cleared of snags and its navigability much improved.

The appropriations, made in six acts, amount to $105,000.

July 1, 1890, balance unexpended	$151.52
Amount appropriated by act approved September 19, 1890	30,000.00
	30,151.52
June 30, 1891, amount expended during fiscal year	9,048.03
July 1, 1891, balance unexpended	21,103.49
July 1, 1891, outstanding liabilities	2,958.64
July 1, 1891, balance available	18,144.85
Amount (estimated) required for completion of existing project	130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W W 1.)

2. *Entrance to Coos Bay and Harbor, Oregon.*—The obstructions which existed at the entrance to this harbor before the works of improvement were begun consisted, first, of the outer bar, which is of sand and shifting in character; and second, of the inner shoals formed by the sands which accumulate when the northwesterly winds prevail. Under the action of these winds the spit on the north side advanced toward the south, contracting the navigable passage, and usually making the outer channel follow a long and tortuous course.

The channel has at times broken through the North Spit, and was then direct, the depth of water was greatest, and vessels could enter or go out without trouble. The project for this improvement, adopted in 1879, was to construct, at an estimated cost of $600,000, a jetty of wood and stone, as might be found best, from a point 250 yards below the northern extremity of Fossil Point, on a line towards the east end of Coos Head.

The present plan, under which operations are progressing, consists in abandoning any further work on the Fossil Point Jetty, and the building of two high-tide jetties of stone; one from Coos Head and one from the southern end of the North Spit out towards the bar, ending at a distance apart of about 1,500 feet. In addition, the project includes the reclamation and holding of the sands of the North Spit, to prevent as far as possible their blowing over into the harbor.

The estimated cost of the work as approved is $2,466,412.20.

The total amount expended to June 30, 1890, was $197,460.41.

The Fossil Point Jetty had been built to a total length of 1,761 feet, but a considerable portion of this consisted simply in a paving of heavy stone on the bottom to prevent scour. The results had been to keep the channel over the bar, which had been constantly improving since work was begun, from varying its position as much as formerly, and to commence an erosion of the North Spit.

Amount expended during the fiscal year ending June 30, 1891, was $72,360.07, of which $12,857.33 was expended on the old project, and $59,502.74 on the new.

There has been practically no change in the results since the preceding Annual Report.

A small amount of stone was placed on the jetty last July, since which nothing has been done, except preliminary work under the new project. The erosion of the North Spit has continued, and a better direction for the inflowing and outflowing currents has been thus secured. The works have not increased the bar depths, and this can not be expected until the north jetty, now under construction, has been very considerably extended.

The total amount appropriated for the improvement of Coos Bay to date has been $338,750, in seven acts.

July 1, 1890, balance unexpended		$16,289.59
Amount appropriated by act approved September 19, 1890		125,000.00
		141,289.59
June 30, 1891, amount expended during fiscal year		72,380.07
July 1, 1891, balance unexpended		68,909.52
July 1, 1891, outstanding liabilities	$10,150.70	
July 1, 1891, amount covered by uncompleted contracts	2,440.00	
		12,590.70
July 1, 1891, balance available		56,318.82

Amount (estimated) required for completion of existing project	$2,341,412.20
Amount that can be profitably expended in fiscal year ending June 30, 1893	750,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W W 2.)

3. *Umpqua River, Oregon.*—Just below Scottsburg, the head of navigation on the Umpqua River, are 5 sandstone bars or ledges 12 feet to 15 feet wide and submerged 1 foot to 2 feet at low tide, on a low-river stage. They are separated by pools about 150 feet wide and from 5 to 10 feet deep at low water.

The Secretary of War having authorized the expenditure of the balance of the appropriation of March 3, 1871, viz, $4,685.89, in improving the river below Scottsburg, a project was submitted and approved in 1885 for making a channel 50 feet wide and 3 feet deep at low water, by drilling and blasting the rock and removing the broken pieces.

In September, 1889, a survey was made of the Umpqua River, and a project submitted for its improvement. This project, approved in October, 1890, provides for the removal of rock bowlders and ledges in the wharf basin at Scottsburg, and below this basin, with a view of opening a channel-way 50 feet in width and 4 feet in depth at low water.

Amount expended to June 30, 1890, was $6,658.42.

The result obtained was a navigable channel 50 feet wide and 2 feet deep at low water, extending nearly through the reefs below Scottsburg, where formerly there was only a foot or less in depth. Amount expended during the fiscal year ending June 30, 1891, was $334.

No results were obtained during the year, no work being done except preparatory to active operations to begin in July, 1891.

The total amount appropriated for the Umpqua River is $33,500, in three acts.

The present appropriation being deemed sufficient for the completion of the existing project, no estimate for additional appropriations is made.

July 1, 1890, balance unexpended	$27.47
Amount appropriated by act approved September 19, 1890	9,000.00
	9,027.47
June 30, 1891, amount expended during fiscal year	334.00
July 1, 1891, balance unexpended	8,693.47
July 1, 1891, outstanding liabilities	670.18
July 1, 1891, balance available	8,023.29

(See Appendix W W 3.)

4. *Siuslaw River, Oregon.*—The Siuslaw River enters the ocean in the midst of a vast shifting sandy beach, and the unconfined channel has a range of about 1 mile, over which it wanders.

The depth on the bar varies from 5 to 12 feet at low water, and the Bar Channel changes very much in position and direction.

Fifty thousand dollars was appropriated for this work in September, 1890. The amount expended during the fiscal year ending June 30, 1891, was $601.96. No work was done and no results were obtained during the year.

By authority of the Secretary of War a Board of Engineers was constituted to formulate and submit a project for improving mouth of Siuslaw River under the appropriation of September 19, 1890; and the

report, dated June 11, 1891, of the Board, contains the following language in reference to beginning work at this locality:

> It would seem to be imperatively necessary, in order that it may be efficiently and economically done, that it be not commenced until an amount sufficient to build the north jetty to its full length up to at least low water be made available. This involves about three-fourths of the total cost of that jetty, or $300,000.

The Board, however, suggests that the available funds be applied to the procurement of the necessary plant and appliances and the commencement of the construction of a dike on the sand spit near the mouth of the river at the northern end of the sandy peninsula, and this suggestion of the Board was approved by the Acting Secretary of War August 4, 1891.

The full report of the Board is herewith, forming part of Appendix W W 4.

Amount appropriated by act approved September 19, 1890	$50,000.00
June 30, 1891, amount expended during fiscal year	601.96
July 1, 1891, balance unexpended	49,398.04
Amount (estimated) required for completion of existing project	700,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W W 4.)

5. *Yaquina Bay, Oregon.*—The usual prevailing depths over the bar at low water before improvement were from 7 feet to 8 feet. Three distinct channels existed, constantly changing in position and depth. The south channel was the one mostly used, though rendered dangerous by rocks. The middle channel, being usually the shoalest, was little used, though free from rocks, while the north channel, long, tortuous, and studded with rocks, was considered unnavigable. The mean rise of tide was 7.1 feet.

The project adopted in 1881 was to construct a dike or jetty on the south side, to cause the south channel to shoal up, with a view to obtaining in the central channel a least depth at high water of 17 feet. As originally projected, the dike was to start from near low-water line, and, rising 2 feet above mean low water, was to run out to sea a distance of 2,500 feet; the beach from high-water level to be protected by sinking gabions and covering the surface with a layer of mattresses and stone.

The stone for the jetty was to be deposited in place from barges, and cribs were to be used if practicable. It was found, however, that cribs could not be used on account of the strong currents and high seas, and that the ocean swell, even in quiet weather, was too great to permit the use of stone barges. Accordingly, the jetty had to be built from the shore end, and by carrying the stone out over a tramway, and was begun at high-tide line instead of at low-tide line, thus making the total projected length of the jetty in 1881 3,700 feet.

In 1884 the jetty was extended shoreward a distance of 316 feet to close a gap that had been washed out by the sea, making the total projected length of the jetty at that time about 4,000 feet.

The present project, adopted in 1888, is to raise the south jetty to full high water without extending it seaward, thus making its total length 3,748 feet, and to construct a mid-tide jetty on the south side of the entrance about 2,300 feet in length, extending from the north head along and behind the reef, putting out from the head to a point opposite the end of the south jetty and distant from it about 1,000 feet.

Amount expended to June 30, 1890, was $383,498.37. At that date the south jetty had been built up to full high water without being extended, and the north jetty had been extended 820 feet. The result was to cause the channel to run in a direct line out to sea and to maintain an ordinary depth of 11 to 12 feet at low water.

Amount expended during the fiscal year ending June 30, 1891, was $67,741.20. The work during the past year has been chiefly confined to the extension of the north jetty, which has materially increased the tendency of the channel to run straight out to sea. Full results, however, can not be realized until the work has further progressed and the north jetty is built out to an equal depth with the south jetty.

There has been a general depth on the bar throughout the year of 11 to 12 feet, and the Oregon Development Company's steamer *Willamette Valley* has suffered but little detention on account of the bar. This depth is liable to be materially reduced during the prevalence of certain winds by the accumulation of sand on the bar and the inadequacy of the only partially confined ebb flow to scour it off.

The recent survey of the bar indicates a controlling depth of 9 feet at low water on the bar.

The appropriations made in seven acts amount to $550,000.

July 1, 1890, balance unexpended	$1,501.63
Amount appropriated by act approved September 19, 1890	165,000.00
	166,501.63
June 30, 1891, amount expended during fiscal year	67,741.20
July 1, 1891, balance unexpended	98,760.43
July 1, 1891, outstanding liabilities	6,476.07
July 1, 1891, balance available	92,284.36
Amount (estimated) required for completion of existing project	165,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	165,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix W W 5.)

6. *Tillamook Bay and Bar, Oregon.*—The channel over the bar is direct and shifts but little, so that the bar is considered one of the safest on the Oregon coast. A fair depth of water is maintained throughout most of the year, and vessels drawing 13 feet can usually enter.

The bay at low tide consists of three channels of fair depth near the entrance, but giving only 1 or 2 feet near the head of the bay.

Tillamook, the principal town of the region, is situated on a tidal slough above the head of the bay, and can be reached only by light-draft vessels at high tide.

A special project for the expenditure of the money appropriated by the act of August 11, 1888, has been approved. This consists in the construction of longitudinal and spur dikes and shore protection works to deepen the water over Dry Stocking Bar, at the mouth of Hoquarton Slough, and to remove snags and overhanging trees from Hoquarton Slough. Amount expended to June 30, 1890, was $4,735.55.

During the year ending June 30, 1890, a survey of the bar and entrance to the bay was made. Hoquarton Slough as far as Tillamook City was cleared of snags. During the winter of 1889 the longitudinal dike and three spur dikes were washed away, so no results of permanent importance had been obtained up to June 30, 1890.

Amount expended during the fiscal year ending June 30, 1891, was $187.40.

No work was done and no results were obtained during the year.

The amount appropriated for the improvement of Tillamook Bay is $5,700 in two acts.

A special project is being prepared for the improvement of Tillamook Bay.

July 1, 1890, balance unexpended	464.46
Amount appropriated by act approved September 19, 1890	500.00
	964.46
June 30, 1891, amount expended during fiscal year	187.40
July 1, 1891, balance unexpended	777.06
July 1, 1891, outstanding liabilities	242.95
July 1, 1891, balance available	534.11

(See Appendix W W 6.)

7. *Nehalem Bay, Oregon.*—Nehalem Bay at high water is about 2 miles long by 1⅓ miles wide at widest part, and is connected with the ocean by a narrow channel extending in a southerly direction about 3 miles. This channel varies in width from 1,000 to 2,000 feet at high tide. A low sandy peninsula about 2½ miles long and one-quarter mile wide lies to the west of this channel, and separates it from the ocean. South of this peninsula the entrance channel shifts within the limits of 1 mile, sometimes occupying a southerly and sometimes a northerly position.

The ordinary bar depth is about 5 to 6 feet at low water. The plan of improvement recommended was to build two high-tide stone jetties, converging until the distance apart is about 500 feet; then, if necessary, running out to sea parallel to each other to such distance as will insure a low-water depth on the bar of at least 8 feet. The amount, $10,000, appropriated September 19, 1890, "for commencement of jetty construction," being inadequate even to procure the necessary plant for beginning work, there were no expenditures for the year ending June 30, 1891. No work was done.

Amount appropriated by act approved September 19, 1890	$10,000.00
July 1, 1891, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	321,927.50

(See Appendix W W 7.)

8. *Upper Columbia and Snake rivers, Oregon and Washington.*—Under the above head it has been deemed proper to officially include the continuous Columbia and Snake rivers from Celilo at the head of the Dalles to Lewiston.

The Upper Columbia and Snake rivers form a continuous line of navigable river, but broken by many rapids, rendering navigation difficult and dangerous. These rapids are nearly always caused by rocky bars with occasional bowlders, and the channels were crooked and narrow. Before improvement the ruling depth on many of these bars was 2 to 3 feet at low water, while some of them were practically impassable. Previous to 1877, $100,000 had been expended in survey and rock removal at the principal rapids. In 1877 a project was made consisting of removing rock bowlders and rocky reefs, and scraping gravel bars, to secure a low water channel of 5½ feet in the Columbia as far as the mouth of the Snake, and 4½ feet in the Snake as far as Lewiston. The estimated cost of this work was $132,000.

Amount expended on project to June 30, 1890, was $130,695.75.

The results obtained to June 30, 1890, consisted in the removal of many bars and the improvement of most of the bad rapids, and generally in obtaining the required depth below the datum assumed at the time the project was adopted.

Amount expended during fiscal year ending June 30, 1891, was $3,746.48. No work was done during the year, and consequently no additional results have been obtained. Though the work already done has lessened the dangers of navigation, it has not, particularly on the Snake River, increased the navigable depth and capacity for the water surface as well as the bed of the river has been lowered.

There has been appropriated up to date for the Upper Columbia and Snake rivers, embraced within the limits of what is now officially known as the Upper Columbia and Snake, $256,000, in thirteen appropriations.

There has never been any complete and connected survey of the Upper Columbia and Snake rivers to determine the extent of their navigability and the country tributary to them which would use the rivers were they opened to the sea.

The Board of Engineers having under consideration the obstructions at The Dalles and Celilo Falls, under date of December 18, 1888, state that the character of the future navigation of the river above Celilo is an element upon which details either of a boat railway or of a canal and locks depend; that no complete project for the river improvement has been made, and none could be made without a proper survey; that a survey is indispensable to determine the possibilities of navigation of the upper river, and that the estimated cost of this survey is $40,000.

July 1, 1890, balance unexpended	$304.25
Amount appropriated by act approved September 19, 1890	20,000.00
	20,304.25
June 30, 1891, amount expended during fiscal year	3,746.48
July 1, 1891, balance unexpended	16,557.77
July 1, 1891, outstanding liabilities	129.99
July 1, 1891, balance available	16,427.78
Amount that can be profitably expended in fiscal year ending June 30, 1893 ($10,000 for work, $40,000 for survey) Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	50,000.00

(See Appendix W W 8.)

9. *Columbia River between head of Rock Island Rapids and foot of Priest Rapids, Washington.*—This portion of the Columbia, about 60 miles in length, flows generally through a deep cañon with banks of precipitous basaltic bluffs from 1,000 to 3,000 feet high. Three principal obstructions to navigation are Rock Island, Cabinet, and Priest rapids. At Rock Island Rapids the channel, which has cut around both sides of a large island of rock, is very much obstructed with reefs, rocks, and points sharply projecting from the shore. This restricted waterway dams up the waters so that they escape over lines of very steep slope. Extensive deposits of gravel nearly choking the channel at low water are caused by a great reef a short distance above the island.

The river has a fall of 10 feet in 3,000 feet and 12½ feet in 8,000 feet at a stage of about 4 feet above low water. At Cabinet Rapids a mass of basaltic rock projects from the left shore, nearly two-thirds across

the channel of the river, deflecting the current and causing it to impinge upon the vertical rocks of the right bank. Masses of rock exist in the channel in and about the main rapids. The fall here is 10 feet in a distance of about 8,000 feet.

Priest Rapids are a collection of seven principal rapids extending over a length of 10 miles of river. The total fall in this distance is at low water 72 feet, and at high water about 63½ feet. In all these rapids the river runs through and over hard, rough, and ragged basaltic rocks.

Under date of February 15, 1890, Maj. W. A. Jones submitted a report and project for the improvement of the river at Rock Island, Cabinet, and Priest rapids, which involved the removal of the worst rocks obstructing navigation, and also the furnishing auxiliary power for assisting boats over the rapids. The auxiliary power recommended was to be obtained by anchoring scows with current wheels at the heads of the principal rapids, and with these, and the necessary lines, to haul the boats up.

Under date of October 1, 1890, Captain Symons submitted a plan for the removal of much more rock than contemplated in the above project, and for putting in at convenient locations iron posts and ringbolts, to which ascending boats could make fast and wind themselves over the rapids, using their steam capstans. The estimated cost of the work proposed was $550,000. In addition it was proposed to continue the survey of the Columbia from the head of Rock Island Rapids to the international boundary line. This project was approved by the Secretary of War, October 8, 1890.

Amount expended during fiscal year ending June 30, 1891, was $31,291.13, of which $2,691.91 was used for survey of river from boundary line to Rock Island Rapids.

The work so far done at Priest and Cabinet rapids has not produced any results of a marked nature. All rocks removed would benefit navigation on the river if there were any, but there is not. The survey is nearly done from the boundary line to the mouth of the Spokane. There has been one appropriation for this work of $70,000.

The officer in charge recommends the abandonment of further work at Priest Rapids under the existing project, being convinced that on account of the great fall and condition of the bed and banks practicable navigation can not be obtained under it.

Amount appropriated by act approved September 19, 1890	$70,000.00
June 30, 1891, amount expended during fiscal year	31,291.13
July 1, 1891, balance unexpended	38,708.87
July 1, 1891, outstanding liabilities	1,531.33
July 1, 1891, balance available	37,177.54
Amount that can be profitably expended in fiscal year ending June 30, 1893 ($50,000 for work and $10,000 for survey). Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	60,000.00

(See Appendix W W 9.)

10. *Chehalis River, Washington.*—The navigable portion of the Chehalis River is about 90 miles in length from Claquato to its mouth. This may well be considered in three sections. First, from the mouth to Montesano, a distance of 12 miles, there is about 18 feet of water at high water, and coasting vessels traverse this portion of the river. Second, from Montesano to Elma, 16 miles, the river is affected by the

tides, and has sufficient water for a channel all the year round, but navigation is obstructed by logs and fallen trees, and in summer by a scarcity of water. Third, above Elma the river is practically blockaded during the summer and fall by snags, shoals, and lack of water. At this time the river is a succession of shoals and pools. On many of the shoals the depth is reported to be only from 6 to 12 inches.

The plan of improvement contemplates removal of snags, overhanging trees, jams, drift heaps, shoals, and other obstructions to navigation.

Amount expended to June 30, 1890, was $9,673.91.

During the year ending June 30, 1890, 56 snags were removed and navigation to this extent improved. From the nature of the work no results of a permanent character affecting the regimen of the river were obtained.

Amount expended during fiscal year ending June 30, 1891, was $940.69. During the year 51 snags, 9 trees, 45 piles, 6 stumps, 4 roots, and a quantity of drift were removed, the river between Montesano and Grays Harbor being thereby cleared of obstructions.

There has been appropriated for the improvement of the Chehalis River, up to date, $13,000 in five acts.

July 1, 1890, balance unexpended	$326.09
Amount appropriated by act approved September 19, 1890	3,000.00
	3,326.09
June 30, 1891, amount expended during fiscal year	940.69
July 1, 1891, balance unexpended	2,385.40
July 1, 1891, outstanding liabilities	112.13
July 1, 1891, balance available	2,273.27

(See Appendix W W 10.)

11. *Skagit, Steilaquamish, Nootsack, Snohomish, and Snoqualmie rivers, Washington.*—The waters of these rivers all rise in the Cascade Range, and flow to the west into Puget Sound, between the forty-eighth and forty-ninth parallels of latitude. In their original condition they carried water enough for the purpose of steamer navigation, but were obstructed by snags, fallen trees, and log-jams. They were the great highways of the country, traveling on land being almost impossible on account of the heavy timber, dense underbrush, and fallen logs.

The Snoqualmie is a branch of the Snohomish. The aggregate length of all is estimated to be about 250 miles.

The plan of improvement contemplates the removal of snags, logs, trees, and other obstructions to navigation. For this purpose a snag boat with an outfit of tools and appliances has been provided. This boat passes from one river to another, doing service in each as far as the necessities of commerce require and the amount of the funds appropriated will admit.

Amount expended to June 30, 1890, was $54,195.17. The results obtained were to keep the rivers open for navigation by the removal of many obstructions.

Amount expended during fiscal year ending June 30, 1891, was $7,923.34.

The snag boat removed during the year a large number of snags, etc., from the Snohomish, Skagit, and Steilaquamish rivers. The results obtained were to greatly benefit navigation. Sixty-nine thousand five hundred dollars has been appropriated for these rivers, in six acts.

July 1, 1890, balance unexpended	$3,304.83
Amount appropriated by act approved September 19, 1890	12,000.00
	15,304.83
June 30, 1891, amount expended during fiscal year	7,923.34
July 1, 1891, balance unexpended	7,381.49
July 1, 1891, outstanding liabilities	160.00
July 1, 1891, balance available	7,221.49
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix W W 11.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Symons, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Captain Symons, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered.

1. *Alsea Bay and River, Oregon.*—Report transmitted to Congress and printed as House Ex. Doc. No. 85, Fifty-first Congress, second session. (See also Appendix W W 12.)

2. *Clark's Fork of the Columbia River (by whatever name called) from the international boundary line to the mouth of the Big Blackfoot River, in the State of Montana.*—(See Appendix W W 13.)

3. *Puyallup River, Washington.*—Report transmitted to Congress and printed as House Ex. Doc. No. 21, Fifty-first Congress, second session. (See also Appendix W W 14.)

4. *D'Wamish and Black rivers, Washington.*—Report transmitted to Congress and printed as House Ex. Doc. No. 27, Fifty-first Congress, second session. (See also Appendix W W 15.)

5. *For a ship channel between Port Townsend Bay, Puget Sound, and Oak Bay, Washington.*—Report transmitted to Congress and printed as House Ex. Doc. No. 92, Fifty-first Congress, second session. (See also Appendix W W 16.)

The required preliminary examination of *North River, Washington*, was made by the local engineer in charge, Captain Symons, and report thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. From the facts and reasons developed by the preliminary examination it was the opinion of Captain Symons and of the Division Engineer that this locality was worthy of improvement. This opinion being concurred in by me, Captain Symons was charged with and has completed its survey and submitted report thereon. The facts brought out by the survey are entirely at variance with those reported as the result of the preliminary examination, in view of which Colonel Mendell considers the river unworthy of improvement. (See Appendix W W 17.)

The required preliminary examination of *Shoalwater Bay, Washington, from and including its entrance, to South Bend, about 2 miles up the Willapah River, and from said South Bend, about 10 miles up said river to Woodward's Landing, with a view to improving the same for navigation*, was made by the local engineer in charge, Captain Symons, and report

thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Captain Symons, and of the Division Engineer, based upon the facts and reasons given, that Shoalwater Bay up to South Bend is not worthy, and that Willapah River from South Bend up to Woodward Landing is worthy of improvement. This opinion being concurred in by me, no further survey of Shoalwater Bay was ordered; but Captain Symons was charged with and has completed survey of Willapah River from South Bend to Woodward Landing, and submitted report thereon. The improvement of this river proposed contemplates deepening the shoals so as to secure a minimum depth of 8 feet at mean low water up to Willapah City (Woodward Landing), at an estimated cost of $31,350. (See Appendix W W 18.)

The required preliminary examination of *Nooksack, Skagit, and Snohomish Rivers, Washington*, was made by the local engineer in charge, Captain Symons, and report thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Captain Symons, and of the Division Engineer, based upon the facts and reasons given, that these rivers are worthy of improvement. The report of the preliminary examination containing sufficient information to indicate to Congress the probable cost of the work required, no further survey appears to be necessary at this time. These rivers have been under improvement by the United States since 1882, and appropriations have been made therefor in all the river and harbor acts since that year. With the appropriation of the $30,000 recommended in the annual report for 1890 everything necessary for their improvement at the present time, consisting of snagging, etc., can be done. The report was transmitted to Congress and printed as House Ex. Doc. No. 38, Fifty-first Congress, second session. (See also Appendix W W 19.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Symons, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Captain Symons, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Captain Symons was charged with and has completed their survey and submitted reports thereon.

1. *Coquille River, Oregon, for deepening channel from Coquille City to Myrtle Point to four feet at mean low depth.*—The improvement proposed, to secure the mean low depth of 4 feet contemplated by the act, consists in overcoming the obstructions to navigation caused by six shoals between Coquille City and Myrtle Point. The plan presented for the accomplishment of this object proposes the removal of snags from the three lower shoals and the construction of wattled pile dikes at the three upper shoals to contract the channel at those points to a width of 50 feet. The total cost of this work is estimated at $26,000. (See Appendix W W 20.)

2. *Coos Bay, Oregon, for improving upper harbor by removal of shoals and in dredging.*—The work proposed at the present time contemplates the construction of a dredge, and the excavation therewith of channels with a depth of 10 feet at low water and a bottom width of 100 feet through the shoals at the lower end of Marshfield and above the coal bunkers in Isthmus Slough. The cost of the work is estimated at $27,390. (See Appendix W W 21.)

3. *The Upper Snake River, Idaho, between the Huntington Bridge and Seven Devils Mining District, with a view of overcoming obstructions to steam-boat navigation.*—The improvement proposed contemplates removing obstructing rocks and reefs, in order to make a channel-way wherever practicable 150 feet wide, and putting in ringbolts and iron posts for the convenience of loaded boats lining up over the worst rapids. The cost of this work is estimated at $80,000. (See Appendix W W 22.)

4. *Nasel River, Washington.*—The proposed improvement contemplates the removal of about 100 snags and of a rock in the channel about 1¾ miles below Nasel Landing. The cost of the work is estimated at $1,500. (See Appendix W W 23.)

5. *Gray's Harbor and Bar, Washington, and extending up Chehalis River to Montesano.*—The proposed improvement contemplates removal of two shoals obstructing navigation of Gray's Harbor, by the construction of dikes; and dredging channel 200 feet wide and 16 feet deep at half-tide through the four shoals, and closing of sloughs by dams in Chehalis River. The estimated cost of this work is $150,000. No improvement of the bar appears to be needed at present. (See Appendix W W 24.)

The required preliminary examination of *Olympia Harbor, Washington, from deep water in Budd's Inlet to Fourth Street Bridge, in the city of Olympia, and separately from said bridge to the mouth of the Des Chutes River at Tumwater*, was made by the local engineer in charge, Captain Symons, and report thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Captain Symons, and of the Division Engineer, based upon the facts and reasons given, that Olympia Harbor, from deep water in Budd's Inlet to Fourth Street Bridge, is worthy, and from the bridge to mouth of Des Chutes River at Tumwater is not worthy of improvement. This opinion being concurred in by me, no further survey from Fourth Street Bridge to Tumwater was ordered; but Captain Symons was charged with survey of Olympia Harbor from deep water in Budd Inlet to the bridge, the report on which will be submitted when received.

The required preliminary examinations of the following localities were made by the local engineer in charge, Captain Symons, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Captain Symons, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Captain Symons was charged with their survey, the reports on which will be submitted when received.

1. *Tillamook Bay and Bar, Oregon.*

2. *Swinomish Slough, Washington, with the view of constructing a ship channel through the same, connecting Saratoga Passage Skagit Bay with Padilla Bay.*

EXAMINATION OF PORT ORFORD HARBOR, OREGON, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

In compliance with the provisions of the act of September 19, 1890, a Board of Engineers, consisting of Col. G. H. Mendell, Maj. Thomas H. Handbury, and Capt. Thomas W. Symons, Corps of Engineers, was constituted by the Secretary of War—

To reëxamine the harbor at Port Orford, in the State of Oregon, with a view of minimizing the project and estimates of the proposed improvement for a harbor of refuge at that point to such proportions as will largely reduce the original estimate

of the cost of such improvement heretofore made under the direction of the Secretary of War, in pursuance of the previous action of Congress, and to report to the Secretary of War, on or before the first Monday in December next, the result of such reexamination, together with the reduced estimate of the cost of such improvement, in the event that such Board shall determine that the same can be made on a less expensive scale than originally recommended.

The report of the Board, dated November 19, 1890, was transmitted to Congress and printed as House Ex. Doc. No. 56, Fifty-first Congress, second session. (See also Appendix W W 25.)

EXAMINATION FOR SHIP CANAL TO CONNECT LAKES UNION, WASHINGTON, AND SAMAMISH, WITH PUGET SOUND, WASHINGTON, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

In compliance with the provisions of the act of September 19, 1890, a Board of Engineers, consisting of Col. G. H. Mendell, Maj. Thomas H. Handbury, and Capt. Thomas W. Symons, Corps of Engineers, was constituted to select and survey location and estimate cost of ship canal to connect Lakes Union, Washington, and Samamish with Puget Sound, Washington. The report of the Board will be submitted when received.

IMPROVEMENT OF WILLAMETTE RIVER, OREGON, AND OF LOWER COLUMBIA RIVER AND ITS TRIBUTARIES, OREGON AND WASHINGTON.

Officer in charge, Maj. Thos. H. Handbury, Corps of Engineers, with Lieut. Edward Burr, Corps of Engineers, under his immediate orders; Division Engineer, Col. G. H. Mendell, Corps of Engineers.

1. *Mouth of Columbia River, Oregon and Washington.*—The project under which this work is being carried on was adopted in 1884. It contemplates providing a channel across the Columbia River Bar, having a depth of 30 feet at mean low tide. This is to be effected by concentrating the water flowing over the bar and increasing the resultant currents to such a degree as to procure the desired depth. The work which is now in progress is the building of a low-tide jetty, starting from Fort Stevens, on the South Cape, and extending in a westerly direction, with a slight curve to the south, out across Clatsop Spit for a distance of 4½ miles, more or less, as circumstances may require, to a point about 3 miles south of Cape Disappointment. The jetty is constructed of stone, resting upon a mattress foundation about 40 feet wide and from 2½ to 5 feet thick. The stone extends to the level of mean lower low water. The material thus far has been placed in position from a jetty tramway, supported upon piles driven along the line of the jetty, and about 24 feet above the level of low tide. The tramway is a double track, 3-foot gauge, railroad, the tracks being 13 feet between centers. The material is landed at the wharf and transported to place over these tracks, which are built in advance of the main work.

Before the commencement of this work the channel or channels over this bar were very capricious in location and variable in depth.

The depths were usually from 19 to 21 feet and the channels varied in number from 1 to 3, and in location through nearly 180 degrees from Cape Disappointment to Point Adams.

The effect of the jetty already constructed is very marked in the building up of Clatsop Spit and in concentrating the waters as they flow over the bar so as to produce the desired scouring effect. There is now a straight out-and-in channel, having a width of one-half mile with a depth nowhere less than 27 feet, and for a width of 1½ miles a depth of

25 feet. The plane of reference being the mean of lowest low waters. At the end of last fiscal year the shortest distance from the 30-foot curve on the outside to the same on the inside of the bar was 1 mile. This distance is now 3,000 feet, with no depth in this space less than 27 feet, and the greater portion of it 28 and 29 feet.

The first appropriation for this improvement was made in the river and harbor act approved July 5, 1884. The total amount appropriated for carrying out the project to the end of the present fiscal year is $1,337,500. The amount expended, including outstanding liabilities, is $1,134,766.06, leaving a balance of $202,733.94 applicable to the further prosecution of the work.

At the end of the last fiscal year the jetty tramway was at station 198+24, and the mattress work at station 194+08. At the end of this year the tramway is at station 239+52, and the mattress work at station 235+40. Station 25+80 being the commencement, the jetty may be regarded as being under construction for a distance of 4 miles and 252 feet. The advance of the jetty tramway during the year was 4,128 feet. The rock in the jetty is now up to low water as far out as station 228+00, or 1,152 feet from the end of the tramway.

Recent surveys made with the view to developing the deepest water to be found on the bar seem to indicate that the jetty may terminate when it has reached a distance of 4¼ miles from its commencement. This being the case, there is now but 1,068 feet of tramway to be built.

The area bare at low water on both sides of the line of the jetty, but more especially on the south side, has increased largely since last report. On the south side a new beach line is forming, which will extend from a point on the present beach south of the Point Adams Light to the end of the jetty. The sand is already bare on this at low run-outs, and between it and the jetty there are many large tracts that are now from 2 to 3 feet high at low water.

It is estimated that $525,000 will be required to complete this work, and recommended that this amount be appropriated for the fiscal year ending June 30, 1893.

The original estimate for the construction of this work was $3,710,000. Of this amount there has been appropriated to June 30, 1891, $1,337,500. There was a balance on hand at that date of $202,733.94, exclusive of outstanding liabilities. This balance will be barely sufficient for the needs of the work until the middle of next April, on or before which time additional funds should be made available. The amount already appropriated, together with the amount estimated for the completion of the work, will bring its total cost to $1,862,500, which sum is $1,847,500 less than the original estimate.

July 1, 1890, balance unexpended		$51,162.08
Amount appropriated by act approved September 19, 1890		475,000.00
		526,162.08
June 30, 1891, amount expended during fiscal year		251,451.62
July 1, 1891, balance unexpended		274,710.46
July 1, 1891, amount covered by uncompleted contracts		71,976.52
July 1, 1891, balance available		202,733.94
Amount (estimated) required for completion of existing project		525,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		525,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix X X 1.)

2. *Construction of canal at the Cascades, Columbia River, Oregon.*—The general scope of the improvement which it is desired to effect at the Cascades of the Columbia River includes a reach of about 4½ miles where the river rushes through a narrow gorge in the Cascade Mountains. The fall in the distance is about 45 feet at high water and 36 feet at low water. The principal obstruction to navigation occurs at the upper end of the reach, known as Upper Cascades. The project for the improvement contemplates that the river should be improved below the Upper Cascades by removing bowlders and projecting points in the bed and banks, so as to give good navigable water from its lowest up to a 20-foot stage. The fall at the Upper Cascades is to be overcome by digging a canal of 3,000 feet in length across the neck of a low projecting spur, around which the river is forced at the entrance to the gorge, and placing in this a lock and other suitable structures, which would permit of the passage of boats up to a 20-foot stage of water in the river, this lock and canal to be so arranged that, should the future necessities of commerce so demand, additional structures may be added which will permit of navigation at much higher stages.

The first part of this project, that of improving the river below the foot of the Upper Cascades, is essentially finished.

The difference of level between the head and foot of the canal as now established is 15 feet at high water, and 24 feet at low water, and the difference in height between high and low water at the foot is 54 feet and at the head 45 feet. The plan on which the future work in the canal with its lock and accessories, is to be prosecuted has for its object to make this portion of the river available for navigation to a stage up to 20 feet at the earliest possible moment, with the funds that are from time to time appropriated for the purpose.

At the commencement of the present fiscal year there was available for the prosecution of the work $7,653.95. At that time active field work was suspended, and had been so since the end of the preceding November, on account of a want of funds. The preparation of drawings and the taking care of the public property pertaining to this improvement were the only work in progress until about the middle of September, 1890, when preparations were commenced with the view to active outdoor work as soon as the river and harbor bill then pending became a law. On September 18 stonecutting was resumed, and on the 20th general operations were commenced. The lock pit was cleared of water between October 4 and 9. Active operations have been in progress from that time until the end of the present fiscal year.

The masonry on the south side for the lower guard and lock gates was built up to the height of the coping and joined to the canal wall of that side, and all preparations are now made for commencing the corresponding masonry on the north side as soon as the river falls so that the lock pit can be pumped out, which will probably be about the 1st of August.

A complete plant has been provided for mixing concrete. It is so arranged that all the materials to be incorporated are brought to the mixers by gravity and the concrete delivered on the wall by the same force. The cost of handling materials and mixing is by this arrangement reduced to a minimum. The capacity of this plant is now 250 cubic yards per day, and can readily be increased at little additional cost to any desired extent.

There is now a large quantity of stone, cut and uncut, and other material, including 8,000 barrels of imported cement, on hand. Everything is now in readiness to push the work forward rapidly.

The funds now available will be substantially exhausted by the end of November in the operations connected with the construction of the north side of the lower lock and guard gate masonry, the construction of the lock wall on the south side, and the upper lock gate masonry on the same side to the height of the bottom of the upper canal, or our reference (88). At that time a suspension will again be necessary, lasting until such time as additional funds are provided for the prosecution of the work. A suspension at that time is very much to be regretted, because during the following 3 months the river is likely to be at low water, which stage is favorable for doing a large amount of work above the upper and below the lower bulkheads, that must be done before the lock can be open to traffic and which would hasten materially that desired event.

During the year the plans and estimates for carrying on this work were carefully revised and reports by the officer in charge upon this revision submitted to Congress. A report in explanation of the conduct of the work by hired labor was also submitted by him. These reports, with other communications pertaining to the same subject, were published, Senate Ex. Doc. No. 72, Fifty-first Congress, second session.

The State of Oregon through its Board of Portage Railway Commissioners was authorized to construct and operate a portage railway with a 3-foot gauge over the Government grounds at Cascade Locks. This road is now under construction.

The amount expended upon this work to the end of this fiscal year is $1,669,325.42. The available balance on hand is $204,691.71, which will be substantially exhausted by the end of November, 1891.

The estimated amount yet to be appropriated for completing the work is $1,745,500.

So much money has already been expended upon this work for which there can be no return until it is substantially completed, that it would seem wise economy to appropriate what is necessary to finish it in one sum at the earliest practical moment. If this can not be done by Congress next session under the estimate for the fiscal year ending June 30, 1893, the completion of the work must then be prolonged at increased expense to a time dependent upon the amounts that are from time to time made available. A suspension of operations of nearly a year in every two years is attended with large expenditures in protecting plant and other property during this time and in repairing and replacing these when work is to be resumed. The inability to take advantage of the proper seasons for carrying on this work, on account of a want of funds, is also a source of large additional expense.

The amount estimated that can be profitably expended during the fiscal year ending June 30, 1893, is $1,500,000, and, in addition to this, $245,500 can be profitably expended before the end of December, 1893.

July 1, 1890, balance unexpended	$7,653.95
Amount appropriated by act approved September 19, 1890	435,000.00
	442,653.95
June 30, 1891, amount expended during fiscal year	234,170.24
July 1, 1891, balance unexpended	208,483.71
July 1, 1891, outstanding liabilities	3,792.00
July 1, 1891, balance available	204,691.71

Amount (estimated) required for completion of existing project	$1,745,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

(See Appendix X X 2.)

3. *Columbia and Lower Willamette rivers below Portland, Oregon.*—The object of this improvement is to make and maintain a navigable channel from the city of Portland, Oregon, to the sea, having a low-water depth of 20 feet. There is included in this reach 12 miles of the Willamette River and 98 miles of the Columbia, measured along the deep-water channel. Before the commencement of the improvement the low-water depth of channel at the shoalest places was between 10 and 15 feet. During some part of the last season a depth of 20 feet was attained at each of these places by the aid of the contraction works thus far constructed assisted by temporary dredging; but at no time could it be said that there was more than 19 feet at the extreme low water throughout the whole distance.

The original project under which this improvement is now being carried on was adopted in 1877, but has been extended and modified somewhat since that time. It contemplates that a navigable low-water-channel, having a depth of 20 feet, shall be maintained by means of permanent construction which shall protect the banks, contract the water way, direct the currents, and control the amount of water that shall pass through sloughs having a detrimental influence upon the main channel. While these constructions are being put in place and until their influence is fully developed dredging has been resorted to in several localities to give a temporary relief to commerce.

The amount expended by the United States since the adoption of the present project, July 1, 1877, is $606,053.03. It appears that previous to that date $221,780.46 had been expended in various operations looking to the improvement of the Willamette and Columbia rivers from Portland to the sea. The aggregate of the appropriations and allotments, including proceeds from sales of property to other appropriations, is $889,745.71. The average for the 25 years since 1866, when the first appropriation was made, is $35,500. In addition to the amount above mentioned the citizens of the city of Portland have in various ways expended a considerable sum, the exact amount of which can not now be ascertained, in assisting to keep open a channel to the sea.

The work done during the year under the project consisted in dredging 13,880 cubic yards of material at St. Helen Bar, leaving a good navigable channel with a depth of 20 feet at low water. A cross dike 1,157 feet long was built behind the present dike to shut off a large quantity of water flowing in that direction and utilize its scouring force over the bar. It is believed that no further dredging to maintain a 20-foot channel will be required at this point. At Post-Office Bar 19,220 cubic yards was dredged. The permeable dams at the head of Martin and Burke sloughs were strengthened and made more compact. It was found that a large body of water was still passing through these sloughs, by stopping which an improvement could be made in the channel over Martin Island Bar.

In connection with the preparation of a project and estimate of cost for obtaining a low-water channel depth of 25 feet from Portland to the sea required by Congress, surveys of the Willamette River from Portland to its mouth, and the Columbia River from Cathlamet to Tongue Point, near Astoria, were made. The maps in preparation from these surveys

are now practically finished. The project and estimate for the improvement will be submitted when completed.

With the funds now available for work under the present project it is proposed to close the chute on the south side of Swan Island and do such dredging on the bars between Portland and the sea as the necessities of the commerce at low-water stages may require; and also to build such permanent structures required by the project as the funds will admit of after paying the expenses of the urgent dredging.

To continue work on the present project for obtaining a low-water depth of channel of 20 feet from Portland to the sea the officer in charge estimates that $100,000 can be advantageously expended during the fiscal year ending June 30, 1893; but, if the project for obtaining a 25-foot depth throughout this distance be approved, this sum should be increased to $700,000.

July 1, 1890, balance unexpended	$7,780.21
Amount appropriated by act approved September 19, 1890	100,000.00
	107,780.21
June 30, 1891, amount expended during fiscal year	45,867.99
July 1, 1891, balance unexpended	61,912.22
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

(See Appendix X X 3.)

4. *Willamette River above Portland, Oregon.*—The project for this improvement was adopted in 1878. It consists in snagging operations, bar-scraping, contraction of water over shoals, and rock removal, with the object of giving easy navigation for light-draft boats from Portland to Eugene City, Oregon, a distance of 172 miles. The mouth of the Yamhill River, 40 miles above Portland, was the head of an inconvenient low-water navigation in a draft of 2½ feet; only 1 foot could be carried above.

The total amount appropriated for this work since present project was adopted is $124,000. At the commencement of the fiscal year there was a balance on hand of $199.21.

Before work could be commenced upon the Willamette River above the falls extensive repairs were necessary to the plant with which this is carried on. A new hull was made for the snag boat *Corvallis*, and a cabin provided. Such of the old machinery as could be used was transferred to this hull and supplemented by new parts. The proportion of the cost of this work charged to this appropriation was $2,073.63. These repairs and additions could not be completed and the boat gotten ready for work before the 10th of February. After shipping up a crew the boat left Portland on the 12th, her captain being under instructions to proceed up the Willamette as far as Harrisburg, removing only the most troublesome obstructions found on the way up, and then drop back, clearing out all snags in the channel as she came down. About this time the rainy season commenced and the river began to rise, so that on reaching Harrisburg there was a 12-foot stage of water. There being no immediate prospect of a fall to a stage favorable for work, the boat was ordered back to Portland at the end of the month and laid up in ordinary, with all hands discharged. During the time that she was out 35 snags and 20 overhanging trees were removed.

During the latter half of November the snag boat *Willamette* worked in the Willamette River at Clackamas Rapids, widening the chute in

the old dam through which the river at that place rushes during low stages. The velocity here is sometimes too great for the power of the boats. The chute was widened 60 feet, with an appreciable benefit to navigation. The expenses of this work, which were $980.50, were paid from the $5,000 allotted in the river and harbor act. No further work could have been done here with a prospect of additional benefit unless at an expenditure which would far exceed even the total of the amount appropriated. In order to produce the radical changes in the character of the river here and at Ross Island that the growing commerce of the Willamette River below the falls will soon make imperatively necessary, a larger amount than is now available will be necessary for either of the localities. At Clackamas Rapids provision must be made for taking care of the heavy sand and gravel coming from the Clackamas River before any permanent improvement can be expected; and at Ross Island retaining dams of considerable extent are necessary to rectify the course of the river, and a large amount of coarse, heavy material must be dredged. Special projects are being prepared and estimates made for the improvement of these two localities, as required by the last river and harbor act.

The river in the vicinity of Ross Island has been carefully resurveyed with a view to its improvement in this locality. There are large iron, stone quarry, and other interests located from 4 to 5 miles above this obstruction, which makes the improvement here very desirable. There is now a low-water depth of 8 feet across this bar.

It is proposed to devote the balance of the funds now available for work on the Upper Willamette to closing chutes, scraping bars, and removing snags as far up as Harrisburg. This will be done with the snag boat *Corvallis* and her crew during the months of July and August. With this work it is expected that a navigable channel at least 2½ feet in depth can be maintained during the low-water season as high up as the town of Corvallis.

With a view to the construction of more permanent works than have heretofore been used for contracting the low water of this river, the officer in charge suggests that if $60,000 be made available in one sum and afterwards yearly appropriations of $10,000, low-water navigation can be permanently maintained.

July 1, 1890, balance unexpended	$199.21
Amount appropriated by act approved September 19, 1890	11,000.00
	11,199.21
June 30, 1891, amount expended during fiscal year	4,734.79
July 1, 1891, balance unexpended	6,464.42
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	60,000.00

(See Appendix X X 4.)

5. *Cowlitz River, Washington.*—The project for the improvement of this river contemplates a removal of the sand bars, snags, overhanging trees, rocks, and other obstructions in the channel from its mouth to a distance of about 50 miles above. Work has been done to Toledo, 30 miles above the mouth. The ruling depth prior to improvement was 14 inches over this reach. It is now 30 inches. The total amount that has been appropriated for this work is $19,000.

As soon as the funds last appropriated became available a small party was organized and sent to the shoal on this river at the mouth of Toutle

River, which gave the most trouble at low-water stages. By scraping away the gravel and concentrating the scattered water into one channel by means of cheaply constructed wing dams, a channel with a depth of 2 feet was obtained where there was virtually nothing before. In these operations about 1,200 cubic yards of gravel were removed. This party also removed 130 obstructions of the nature of logs, stumps, rock heaps, etc., from the navigable channel of the river. These operations covered the river from its mouth to Toledo.

Work of this character can be prosecuted to best advantage on this river from about the middle of September to the 1st of December, when the winter rains commence. To provide for future work upon this stream $2,500 was expended on repairs to the snag boat *Corvallis*. This boat will be available for work here during the low-water season of this fall.

It is estimated that $3,000 can be profitably expended upon the improvement of the navigation of this river in accordance with the project during the fiscal year ending June 30, 1893.

Amount appropriated by act approved September 19, 1890	$8,000.00
June 30, 1891, amount expended during fiscal year	4,082.73
July 1, 1891, balance unexpended	3,917.27
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	3,000.00

(See Appendix X X 5.)

6. *Young's and Klaskuine rivers, Oregon.*—The project for this improvement contemplates the removal of snags, sunken logs, and overhanging trees from Young's River as far up as the lower end of the cut-off, a distance of 7 miles; and also from the channel of the Klaskuine as far up as Kamm's Wharf, a distance of about 2 miles. This latter river empties into the former 6 miles above Young's Bay.

A Government snag boat was sent into these streams and worked during the latter half of December, removing 61 snags and logs, which effected a tolerable channel, giving a draft of 7 feet during high tide to the limits named.

The sum of $600 was expended in repairs to the snag boat *Corvallis*, which will be used for future operations upon these streams.

The total amount appropriated for this work was $1,600. The balance now available, $393.21, will be sufficient to complete the work according to the project. No further appropriation is asked.

Amount appropriated by act approved September 19, 1890	$1,600.00
June 30, 1891, amount expended during fiscal year	1,206.79
July 1, 1891, balance unexpended	393.21

(See Appendix X X 6.)

7. *Gauging waters of Columbia River, Oregon, and Washington.*—The object of these gaugings is to ascertain and keep a record of the fluctuations of the Columbia River with the view to gathering information that may be useful in works of improvement on the river, and also by gauges established at various points to indicate to pilots, captains, and others interested in navigation, the stage of water on crossings and places of difficult navigation.

A self-registering tide gauge has been in operation at Astoria, Oregon, and one at Cathlamet, Wash., during the entire year.

Daily sheets from the Astoria gauge were exhibited on a bulletin

board in that city. These show the stage of water and condition as to roughness on the bar at the mouth of the river, and are of great service to commerce.

July 1, 1890, balance unexpended	$1,476.49
June 30, 1891, amount expended during fiscal year	514.17
July 1, 1891, balance unexpended	962.32
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	1,500.00

(See Appendix X X 7.)

8. *Removing sunken vessels or craft obstructing or endangering navigation.*—The wreck of the ship *Sylvia de Grasse*, sunk in 1849, lies near the edge of the channel in Columbia River in front of Upper Astoria, Oregon. It is an obstruction to the navigation of the river by the river boats. Proposals for its removal, received in response to advertisement of April 30, 1890, were rejected on account of being excessive. The wreck will be removed at a favorable opportunity by the use of hired labor and the Government snag boat and outfit.

(See Appendix X X 8.)

EXAMINATIONS AND SURVEYS FOR IMPROVEMENT, TO COMPLY WITH REQUIREMENTS OF RIVER AND HARBOR ACT APPROVED SEPTEMBER 19, 1890.

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Handbury, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Major Handbury, and of the Division Engineer, based upon the facts and reasons given, that these localities are not worthy of improvement. The conclusions of these officers being concurred in by me, no further surveys were ordered. The reports were transmitted to Congress and printed as executive documents of the Fifty-first Congress, second session.

1. *Willamette River, Oregon, deepening channel on west side of Swan Island.*—Printed as House Ex. Doc. No. 74. (See also Appendix X X 9.)

2. *Young's Bay channel from the ship channel of the Columbia River to the head of Young's Bay, Oregon, a distance of* 1½ *miles, with a view to improving the same by dredging, so as to secure a depth of* 18 *feet at low tide.*—Printed as House Ex. Doc. No. 67. (See also Appendix X X 10.)

3. *Deep, Skamakawa [Skamokawa], and Crooked Rivers, Washington.*—Printed as House Ex. Doc. No. 24. (See also Appendix X X 11.)

The required preliminary examination of *Lower Columbia River, Oregon, on south side, between Astoria and Wood's Landing for snagging*, was made by the local engineer in charge, Major Handbury, and report thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. This section of the river is included within the scope of the project for improving Lower Willamette and Columbia rivers, and all obstructions in the nature of snags can be removed by the snag boat provided for such work in the Columbia River. No further survey, therefore, appears to be necessary at this time. The report was transmitted to Congress and printed as House Ex. Doc. No. 61, Fifty-first Congress, second session. (See also Appendix X X 12.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Handbury, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Major Handbury, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Major Handbury was charged with and has completed their survey and submitted reports thereon.

1. *The Yamhill River, Oregon, from its mouth to McMinnville, with a view of improving the same by removing snags and other obstructions.*—The proposed improvement contemplates the removal of obstructions, which consist principally of overhanging trees, snags, etc., at an estimated cost of $3,000. (See Appendix X X 13.)

2. *Lewis and Clarke's River, Oregon, for snagging.*—The improvement proposed contemplates the removal of snags and other similar obstructions, at an estimated cost of $1,200. (See Appendix X X 14.)

3. *Gray's River, Washington.*—The improvement proposed contemplates the removal of obstructions, principally snags, a few overhanging trees and a sand bar, at an estimated cost of $2,500. (See Appendix X X 15.)

4. *Gray's River, Washington, for snagging.*—The reports covering this item are included in those on "Gray's River, Washington," the two localities being identical. (See Appendix X X 15.)

The required preliminary examinations of the following localities were made by the local engineer in charge, Major Handbury, and reports thereon submitted through Col. G. H. Mendell, Corps of Engineers, Division Engineer, Pacific Division. It is the opinion of Major Handbury, and of the Division Engineer, based upon the facts and reasons given, that these localities are worthy of improvement. The conclusions of these officers being concurred in by me, Major Handbury was charged with their survey, the reports on which will be submitted when received.

1. *Willamette River, Oregon, for improvement of navigation at Clackamas Rapids and Ross Island and near city of Corvallis.*

2. *The Lower Willamette and Columbia Rivers, Oregon, with a view of securing 25 feet at low water from Portland to the mouth of the Columbia.*

3. *Columbia River, Washington, from the mouth of Willamette River to the upper limits of the city of Vancouver, with a view of establishing a ship-channel.*

EXAMINATIONS, SURVEYS, AND CONTINGENCIES OF RIVERS AND HARBORS.

For examinations, surveys, and contingencies of rivers and harbors an appropriation of $250,000 should be made, as follows:

For examinations, surveys, and contingencies, and for incidental repairs, for rivers and harbors, for which there may be no special appropriation..	$225,000
For expenses connected with the inspection of bridges reported as obstructions to navigation, the service of notice required in such cases, and the location of harbor lines, as required by the act of September 19, 1890; and for expenses connected with the examinations and reports by officers of the Corps of Engineers and by Boards of Engineers upon plans for bridges authorized by law to be constructed, and upon bridge bills, reports on which may be called for by Congress	25,000
	250,000

SUPERVISION OF THE HARBOR OF NEW YORK.

Supervisor, Capt. W. A. Kirkland, United States Navy.

The office of the supervisor of the harbor of New York was created by act of Congress approved June 29, 1888, entitled "An act to prevent obstructive and injurious deposits within the harbor and adjacent waters of New York City by dumping or otherwise, and to punish and prevent such offenses."

Under the provisions of section 5 of the act a line officer of the Navy was designated to discharge the duties created by the act, under the direction of the Secretary of War. On May 23, 1889, the Secretary of War directed that all communications in connection with these duties should be addressed to him through this office, and on February 1, 1890, he further directed that the powers conferred upon him by the act should be exercised through the Chief of Engineers.

The report of the supervisor of the harbor, describing the operations in his charge for the fiscal year ending June 30, 1891, is submitted as Appendix Y Y.

The estimate of funds required for this service for the fiscal year ending June 30, 1893, is given in the above mentioned report as follows:

ESTIMATE OF APPROPRIATION REQUIRED FOR THE FISCAL YEAR ENDING JUNE 30, 1893, BY THE SUPERVISOR OF THE HARBOR OF NEW YORK.

For pay of inspectors, deputy inspectors, office force, and expenses of office.	$20,000
For pay of crew and maintenance of steamer *Nimrod*	10,000
For pay of crew and maintenance of steamer *Argus*	10,000
For purchase or construction of 2 steam-tugs	60,000
For pay of crew and maintenance of 2 steam-tugs to be purchased or constructed	20,000
Total	120,000

MISSISSIPPI RIVER COMMISSION.

Commissioners, Col. C. B. Comstock, Corps of Engineers, President; Lieut. Col. Chas. R. Suter, Corps of Engineers; Maj. O. H. Ernst, Corps of Engineers; Henry L. Whiting, Assistant, U. S. Coast and Geodetic Survey; B. M. Harrod, Robert S. Taylor, and Henry Flad.

The Mississippi River Commission, organized under the provisions of the act of Congress of June 28, 1879, reports to and receives instructions from the Secretary of War through this office.

The report of the Commission for the fiscal year ending June 30, 1891, relating to surveys of the river, works of construction, and improvement between the mouth of Ohio River and the head of the Passes, etc., is submitted as Appendix Z Z.

The estimate of funds required for the service of the Commission for the fiscal year ending June 30, 1893, is stated in the above mentioned report, as follows:

ESTIMATE OF FUNDS FOR THE MISSISSIPPI RIVER COMMISSION FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

For improving Mississippi River from head of the Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission; for the building of levees, and for surveys from the head of the Passes to the headwaters	$6,000,000

For work at harbor of—	
Memphis	$25,000
Greenville	350,000
Vicksburg	175,000
Natchez	350,000
New Orleans	200,000
For rectification of Red and Atchafalaya rivers	350,000

MISSOURI RIVER COMMISSION.

Commissioners, Lieut. Col. Charles R. Suter, Corps of Engineers, President; Maj. A. Mackenzie, Corps of Engineers: Maj. O. H. Ernst, Corps of Engineers; Garland C. Broadhead, and Richard S. Berlin.

The Missouri River Commission, organized under the provisions of the act of July 5, 1884, reports to and receives instructions from the Secretary of War through this office.

The report of the Commission for the fiscal year ending June 30, 1891, in regard to the operations in its charge, is submitted as Appendix A A A.

The estimate of funds required for the service of the Commission for the fiscal year ending June 30, 1893, is stated in the above mentioned report as follows:

ESTIMATES FOR CONTINUING WORKS OF IMPROVEMENT FOR THE FISCAL YEAR ENDING JUNE 30, 1893.

Salaries of Commission, office and traveling expenses, surveys and observations, gauges, etc	$100,000
Improving Missouri River between Sioux City and the mouth of the river	3,000,000
Total	3,100,000

HARBOR LINES.

The section in the river and harbor act of 1888 authorizing the establishment of harbor lines, was amended and reënacted by the river and harbor act approved September 19, 1890, as follows:

SEC. 12. That section 12 of the river and harbor act of August 11, 1888, be amended and reënacted so as to read as follows:

Where it is made manifest to the Secretary of War that the establishment of harbor lines is essential to the preservation and protection of harbors, he may, and is hereby authorized, to cause such lines to be established, beyond which no piers, wharves, bulkheads or other works shall be extended or deposits made, except under such regulations as may be prescribed from time to time by him; and any person who shall willfully violate the provisions of this section, or any rule or regulation made by the Secretary of War in pursuance of this section, shall be deemed guilty of a misdemeanor, and, on conviction thereof, shall be punished by a fine not exceeding $1,000, or imprisonment not exceeding one year, at the discretion of the court for each offense.

In cases where it had been made manifest to the Secretary of War that the establishment of certain harbor lines is essential to the preservation and protection of the harbors, the cases were referred to officers in local charge of the district in which the harbors are located or to boards of engineers specially appointed for the purpose, for consideration and report. The necessary examinations having been made, reports with maps were rendered, which were submitted to the Secretary of War by the Chief of Engineers, with recommendation that the lines as indicated be approved, and that the approval be placed upon the maps showing the harbor lines.

Under the requirements of law as cited, and in the manner described, harbor lines have been established as follows:

HARBOR LINES AT LUBEC, MAINE.

Lieut. Col. Jared A. Smith, Corps of Engineers, in compliance with instructions from this office, made report dated March 2, 1891; report submitted to the Secretary of War March 5, 1891; approved March 6, 1891.

(See Appendix A 30.)

HARBOR LINES IN KENNEBEC RIVER AT BATH, MAINE.

Lieut. Col. Jared A. Smith, Corps of Engineers, in compliance with instructions from this office, made report dated July 9, 1891; report submitted to the Secretary of War July 13, 1891; approved July 15, 1891.

(See Appendix A 31.)

HARBOR LINES IN BOSTON HARBOR, MASSACHUSETTS.

The Board of Engineers on harbor lines for Boston Harbor, Massachusetts, consisting of Col. H. L. Abbot, Lieut. Cols. G. L. Gillespie and S. M. Mansfield, and Maj. W. R. Livermore, Corps of Engineers, was constituted by Special Orders No. 11, Headquarters, Corps of Engineers, January 30, 1889.

a. Charles River from Market Street Bridge to the Watertown Dam.—Report dated January 23, 1891; submitted to the Secretary of War January 28, 1891; approved January 29, 1891.

b. North side of the "Reserved Channel," north side of South Boston flats, and around Castle Island.—Report dated January 23, 1891; submitted to the Secretary of War January 28, 1891; approved January 29, 1891.

(See Appendix B 26.)

HARBOR LINES IN NEW YORK HARBOR AND ITS ADJACENT WATERS.

The Board of Engineers on harbor lines for New York Harbor and its adjacent waters, consisting of Colonels Henry L. Abbot, Wm. P. Craighill, C. B. Comstock, and D. C. Houston, and Lieut. Col. G. L. Gillespie, Corps of Engineers, was constituted by Special Orders No. 11, Headquarters, Corps of Engineers, January 30, 1889.

a. East side of Manhattan Island from East Eighty-first street north to Third Avenue Bridge; west side of Manhattan Island from West Eighty-first street north to Spuyten Duyvel Creek; west bank of North River from Guttenberg, New Jersey, north to Bloomer, New Jersey; Spuyten Duyvel Creek through the Harlem River to Third Avenue Bridge; north shore of Bronx Kills from Third Avenue Bridge eastward to Bungay street (Port Morris); and Blackwell, Ward, Randall, and Sunken Meadow islands.—Report dated September 17, 1890; submitted to the Secretary of War October 15, 1890; approved October 18, 1890.

b. Raritan River from Crab Island to head of navigation at New Brunswick, New Jersey.—Report dated October 21, 1890; submitted to the Secretary of War October 30, 1890; approved November 3, 1890.

c. Newtown Creek, New York, between terminals at Whale Creek and

Dutch Kills, established by the Secretary of War February 8, 1890, and Metropolitan avenue, the present head of navigation of the creek.—Report dated December 16, 1890; submitted to the Secretary of War December 27, 1890; approved December 29, 1890.

d. East River, New York: along the north shore from Port Morris eastward to Throg Neck, including entrance to Bronx River and Westchester Creek; along the south shore from Lawrence Point eastward to Willets Point, including Bowery and Flushing bays; and around North Brother, South Brother, Berrien, and Riker islands.—Report dated December 23, 1890; submitted to the Secretary of War January 8, 1891; approved January 9, 1891.

e. Jersey Flats, west side of Upper Bay, New York Harbor, extending from mouth of Hudson River at Jersey City to Constable Point, Bergen Neck, New Jersey.—Report dated June 9, 1891; submitted to the Secretary of War June 23, 1891; approved August 19, 1891.

f. Modification of pier and bulkhead line on the north shore of Staten Island, between John street and Houseman avenue, produced.—Report dated July 15, 1890; submitted to the Secretary of War August 11, 1890; approved August 15, 1890.

(See Appendix E 19.)

HARBOR LINES IN THE PORT OF PHILADELPHIA, PENNSYLVANIA.

The Board of Engineers on harbor lines for the port of Philadelphia, consisting of Colonels Wm. P. Craighill and C. B. Comstock and Maj. C. W. Raymond, Corps of Engineers, was constituted by Special Orders No. 20, Headquarters, Corps of Engineers, February 25, 1889.

a. East shore of Delaware River from Kaighn Point to Cooper Point along the water-front of Camden, New Jersey.—Report dated October 10, 1890; submitted to the Secretary of War October 30, 1890; approved November 1, 1890.

b. West shore of Delaware River from Moore street to Otis street along the water-front of Philadelphia, Pennsylvania—Report dated January 2, 1891; submitted to the Secretary of War January 17, 1891; approved January 20, 1891.

(See Appendix G 23.)

HARBOR LINES AT NEW CASTLE, DELAWARE.

W. F. Smith, United States Agent, Major of Engineers, U. S. Army Retired, in compliance with instructions from this office, made report dated June 22, 1891; report submitted to the Secretary of War June 25, 1891; approved June 26, 1891.

(See Appendix H 29.)

HARBOR LINES IN ST. AUGUSTINE HARBOR, FLORIDA.

The Board of Engineers on harbor lines for St. Augustine Harbor, Florida, consisting of Capt. W. M. Black, and First Lieutenants O. M. Carter and D. Du B. Gaillard, Corps of Engineers, constituted by Special Orders No. 3, Headquarters, Corps of Engineers, January 8, 1890, made report dated January 26, 1891; report submitted to the Secretary of War February 18, 1891; approved February 20, 1891.

(See Appendix O 20.)

HARBOR LINES AT DULUTH, MINNESOTA, BAY OF ST. LOUIS, SUPERIOR BAY, AND THE ADJACENT WATERS, MINNESOTA AND WISCONSIN.

The Board of Engineers on harbor lines for Portage Lake, Michigan (see Appendix K K 13), consisting of Col. O. M. Poe, Maj. James B. Quinn, and Capt. W. L. Marshall, Corps of Engineers, charged by Special Orders No. 46, Headquarters, Corps of Engineers, July 25, 1890, with the consideration of harbor lines for Duluth, Minn., Bay of St. Louis, Superior Bay, and the adjacent waters, Minnesota and Wisconsin, made report dated August 23, 1890; report submitted to the Secretary of War September 5, 1890; approved September 8, 1890.

(See Appendix K K 12.)

HARBOR LINES IN PORTAGE LAKE, MICHIGAN.

Under the provisions of act approved June 20, 1890, a Board of Engineers on harbor lines in Portage Lake, Michigan, consisting of Col. O. M. Poe, Maj. James B. Quinn, and Capt. W. L. Marshall, Corps of Engineers, was constituted by Special Orders No. 40, Headquarters, Corps of Engineers, July 5, 1890. Report was made under date of December 11, 1890; submitted to the Secretary of War January 2, 1891; approved January 5, 1891. The report was, under the provisions of sections 17 and 18 of river and harbor act approved September 19, 1890, providing for examinations and surveys of certain localities, transmitted to Congress and printed as House Ex. Doc. No. 200, Fifty-first Congress, second session.

(See also Appendix K K 13.)

HARBOR LINES IN CHICAGO HARBOR, ILLINOIS.

The Board of Engineers on harbor lines for Chicago Harbor, Illinois, consisting of Col. O. M. Poe, Maj. Chas. E. L. B. Davis, and Capt. W. L. Marshall, Corps of Engineers, constituted by Special Orders No. 61, Headquarters, Corps of Engineers, September 11, 1890, made report dated September 17, 1890; report submitted to the Secretary of War September 19, 1890; approved September 22, 1890.

(See Appendix M M 8.)

HARBOR LINES IN SAN FRANCISCO HARBOR AND ADJACENT WATERS, CALIFORNIA.

The Board of Engineers on harbor lines for San Francisco Harbor and adjacent waters, consisting of Col. G. H. Mendell, Lieut. Col. W. H. H. Benyaurd, and Maj. W. H. Heuer, Corps of Engineers, constituted by Special Orders No. 51, Headquarters, Corps of Engineers, October 11, 1888, made report dated June 8, 1891, recommending modification of harbor lines on Port Costa Front, south shore of Karquinez Straits, established August 2, 1890; report submitted to the Secretary of War June 16, 1891; approved June 17, 1891.

(See Appendix T T 3.)

HARBOR LINES AT SAN PEDRO, WILMINGTON HARBOR, CALIFORNIA.

The Board of Engineers on harbor lines at San Pedro, Wilmington Harbor, California, consisting of Col. G. H. Mendell, Lieut. Col. W. H. H. Benyaurd, and Maj. W. H. Heuer, Corps of Engineers, constituted

by Special Orders No. 20, Headquarters, Corps of Engineers, March 25, 1891, made report dated July 18, 1891; report submitted to the Secretary of War July 27, 1891; approved July 28, 1891.

(See Appendix U U 14.)

HARBOR LINES IN HUMBOLDT BAY, CALIFORNIA.

The Board of Engineers on harbor lines for Humboldt Bay, California, consisting of Col. G. H. Mendell, Lieut. Col. W. H. H. Benyaurd, and Maj. W. H. Heuer, Corps of Engineers, constituted by Special Orders No. 55, Headquarters, Corps of Engineers, August 28, 1890, made report dated June 8, 1891; report submitted to the Secretary of War June 16, 1891; approved June 17, 1891.

(See Appendix V V 7.)

HARBOR LINES IN ASTORIA HARBOR, OREGON.

The Board of Engineers on harbor lines for Astoria Harbor, Oregon, consisting of Col. G. H. Mendell, Maj. Thos. H. Handbury, and Capt. Thomas W. Symons, Corps of Engineers, constituted by Special Orders No. 34, Headquarters, Corps of Engineers, June 20, 1890, made report dated April 9, 1891; report submitted to the Secretary of War April 21, 1891; approved April 22, 1891.

(See Appendix X X 16.)

BRIDGING NAVIGABLE WATERS OF THE UNITED STATES.

The plans and locations of the following bridges authorized by acts of Congress, having been found to comply with the requirements of said acts, have been approved by the Secretary of War, and copies sent to the officers of the Corps of Engineers in charge of the river and harbor districts in which the bridges are to be built, in order that they might supervise the construction so far as to see that the bridges are built in accordance therewith:

1. *Bridge of Winona and Southwestern Railway Company across Mississippi River at Winona, Minnesota.*—Act approved August 13, 1888.

Plan and location submitted by the company June 2, 1890; approved by the Assistant Secretary of War July 9, 1890; copy sent to Maj. A. Mackenzie, Corps of Engineers, July 15, 1890.

September 7, 1891, Major Mackenzie reported the completion of this bridge.

2. *Bridge across Powow River, between the towns of Amesbury and Salisbury, Massachusetts.*—The river and harbor act of August 11, 1888, making appropriation for the improvement, by dredging, of Powow River, provides—

> That this sum shall not be expended until the towns of Amesbury and Salisbury, or either of them, shall have caused such a draw to be placed in the present bridge over said river as may be approved by the Secretary of War.

The same proviso is attached to the appropriation made by the river and harbor act approved September 19, 1890, for improvement of this river.

On March 23, 1889, the construction of a draw of 56 feet width, as proposed by the Berlin Iron Bridge Company March 11, 1889, was approved by the Secretary of War. This plan being unsatisfactory to the

town authorities, on March 28, 1889, the Berlin Iron Bridge Company submitted a plan for a leaf draw of 35 feet width, which was approved by the Secretary of War April 10, 1889; Lieut. Col. S. M. Mansfield, Corps of Engineers, was so advised April 11, 1889.

August 25, 1890, the commissioners of Essex County, Massachusetts, to whom the construction of the bridge had been committed by the legislature of the State, submitted a plan for a pivot draw, to be constructed instead of the leaf draw approved by the War Department April 10, 1889. The plan for this pivot draw was approved by the Acting Secretary of War September 2, 1890, and Lieutenant-Colonel Mansfield was so advised September 4, 1890.

3. *Bridge of Clinton and Illinois Bridge Company across Mississippi River near Clinton, Iowa.*—Act approved July 16, 1888; amended by act approved March 1, 1890.

Plans for a bridge to be located at Stony Point, submitted by the company February 1, 1889, were afterward withdrawn, and new plans, with location below the bridge of the Chicago and Northwestern Railway Company, submitted in their stead, were disapproved by the Secretary of War July 16, 1889, as not complying with the law of July 16, 1888.

Plans for a high bridge, to be located at Stony Point, received November 12, 1889, were referred for examination and report to a Board of Engineers, consisting of Lieut. Col. Chas. R. Suter, Maj. A. Mackenzie, and Capt. W. L. Marshall, Corps of Engineers, constituted by authority of the Secretary of War, by paragraph 1, Special Orders No. 10, Headquarters, Corps of Engineers, March 11, 1890. March 31, 1890, the board reported adversely on the Stony Point location and suggested that the bridge be constructed near the existing railway bridge, about a mile below Stony Point. July 17, 1890, plan and location conforming to the report of the Board were submitted by the company. These revised plans were referred to the Board of Engineers, which, under date of July 31, 1890, recommended their approval with certain qualifications. This report was approved by the Assistant Secretary of War August 7, 1890.

Plans submitted August 28, 1890, conforming with the recommendations of July 31, 1890, of the Board of Engineers, were approved by the Acting Secretary of War September 22, 1890; copy sent to Maj. A. Mackenzie, Corps of Engineers, September 27, 1890.

January 21, 1891, the company submitted for approval a proposed modification in the plans for the superstructure of certain spans of the bridge; this modification was approved by the Assistant Secretary of War February 10, 1891, and copy of the drawing showing the approved modification was sent to Major Mackenzie March 24, 1891.

June 26, 1891, the company submitted for approval a proposed modification of the arrangement of the east channel span; this modification was approved by the Acting Secretary of War July 10, 1891, and copy of the drawing showing the approved modification was sent to Major Mackenzie July 31, 1891.

4. *Bridge of Leavenworth and Platte County Bridge Company across Missouri River between Leavenworth, Kansas, and Platte County, Missouri.*—Act approved* February 25, 1889; amended by act approved July 25, 1890.

Under the act of February 25, 1889, which provided for a ponton bridge, plan and location were approved by the Secretary of War June

* An act similar to this was approved March 2, 1889.

20, 1889. (See Annual Report of the Chief of Engineers for 1889, page 372).

The act of July 25, 1890, authorized the construction of a pivot drawbridge instead of the ponton bridge provided for by the act of February 25, 1889. Plan and location were submitted by the company August 26, 1890; approved by the Assistant Secretary of War September 25, 1890; copy sent to Lieut. Col. Charles R. Suter, Corps of Engineers, October 1, 1890.

5. *Bridge of Charleston and South Side Bridge Company across Great Kanawha River at Charleston, West Virginia.*—General act providing for construction of bridges across Great Kanawha River approved March 3, 1887.

Plan and location submitted by the company May 28, 1890, were, under the provisions of the act, referred for consideration and report to a Board of Engineers, consisting of Col. Wm. P. Craighill, Maj. D. W. Lockwood, and Capt. Edward Maguire, Corps of Engineers, constituted, by authority of the Assistant Secretary of War, by paragraph 1, Special Orders No. 28, Headquarters, Corps of Engineers, May 31, 1890. The report of the Board, submitted under date of July 11, 1890, was approved by the Acting Secretary of War July 29, 1890. Revised plans for the bridge, submitted by the company August 18, 1890, conforming to the recommendations of the Board, were approved by the Assistant Secretary of War September 26, 1890; copy sent to Col. Wm. P. Craighill, Corps of Engineers, September 30, 1890.

April 20, 1891, Colonel Craighill reported that the bridge was completed in conformity with the requirements of the act, except that the clear height of the main span was five-sixteenths of an inch too low at the Charleston end.

6. *Bridge of Oregon Railway Extensions Company across Columbia River near Vancouver, Washington.*—Act approved August 29, 1890.

Plan and location submitted by the company September 4, 1890; approved by the Assistant Secretary of War September 29, 1890; copy sent to Maj. Thomas H. Handbury, Corps of Engineers, October 7, 1890.

7. *Bridge of The South Bound Railroad Company across Savannah River, near Sister's Ferry, Effingham County, Georgia.*—Act approved August 7, 1890.

Plan and location submitted by the company August 14, 1890; approved by the Acting Secretary of War November 4, 1890; copy of approved plans sent to Lieut. O. M. Carter, Corps of Engineers, November 6, 1890.

8. *Bridge of Houston, Central Arkansas and Northern Railroad Company across Little River, Louisiana.*—Act approved August 6, 1888; amended by act approved August 18, 1890.

Plan and location submitted by the company September 9, 1890; approved by the Acting Secretary of War November 5, 1890; copy sent to Capt. J. H. Willard, Corps of Engineers, November 10, 1890.

On account of opposition of the navigation interests to this approved plan, a new plan, for a bridge with a draw, was submitted by the company May 30, 1891; approved by the Assistant Secretary of War June 15, 1891; copy sent to Capt. J. H. Willard, Corps of Engineers, June 17, 1891.

9. *Bridge of Wrightsville and Tennille (Tennville) Railroad Company across Oconee River, near Dublin, Georgia.*—Act approved May 21, 1890.

Plan and location submitted by the company August 12, 1890; approved by the Acting Secretary of War November 17, 1890; copy sent to Lieut. O. M. Carter, Corps of Engineers, November 20, 1890.

10. *Bridge of Houston, Central Arkansas and Northern Railroad Company across Ouachita River near Columbia, Louisiana.*—Act approved August 6, 1888; amended by act approved August 18, 1890.

Plan and location submitted by the company September 9, 1890, and amended plan and location received November 11, 1890; approved by the Assistant Secretary of War November 25, 1890; copy sent to Capt. J. H. Willard, Corps of Engineers, December 4, 1890.

11. *Bridge of Kansas City Terminal Railway Company across Missouri River near Quindaro, Kansas, about 8.6 miles above Hannibal and St. Joseph Railway bridge at Kansas City.*—Act approved March 1, 1889; amended by act approved June 28, 1890.

Plan and location submitted by the company October 10, 1890; approved by the Assistant Secretary of War December 1, 1890; copy sent to Lieut. Col. Charles R. Suter, Corps of Engineers, December 15, 1890.

12. *Bridge of city of St. Paul, Minnesota, across Mississippi River at St. Paul, Minnesota.*—Act approved July 5, 1884; amended by act approved August 29, 1890.

Plan and location submitted by the city August 27, 1890; approved by the Assistant Secretary of War December 17, 1890; copy sent to Maj. A. Mackenzie, Corps of Engineers, December 20, 1890.

13. *Bridge of Cable City Bridge Construction Company across Arkansas River at Dardanelle, Arkansas.*—Act approved September 30, 1890.

Plan and location submitted by the company October 25, 1890; approved by the Assistant Secretary of War December 23, 1890; copy sent to Capt. H. S. Taber, Corps of Engineers, December 30, 1890.

Application dated May 2, 1891, for authority to erect an additional tower for operating the draw was approved, under certain conditions, by the Secretary of War May 16, 1891.

14. *Bridge of Houston, Central Arkansas and Northern Railroad Company across Red River at Upper Falls, near Alexandria, Louisiana.*—Act approved August 6, 1888; amended by act approved August 18, 1890.

The company submitted plan and location September 9, 1890, and amended plan November 8, 1890. Many objections and protests being raised against the proposed location of the bridge, the matter was referred for consideration and report to a Board of Engineers, consisting of Maj. A. M. Miller, Capt. J. H. Willard, and Capt. H. S. Taber, Corps of Engineers, constituted, by direction of the Assistant Secretary of War, by Special Orders No. 82, Headquarters, Corps of Engineers, December 1, 1890. In accordance with the recommendations of this Board, as expressed in its report, dated December 16, 1890, the plan and location were approved by the Assistant Secretary of War December 29, 1890; copy sent to Capt. J. H. Willard, Corps of Engineers, February 3, 1891.

15. *Bridge of Macon, Dublin and Savannah Railroad Company across Oconee River at Dublin, Georgia.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Georgia.

Plan and location submitted by the company November 28, 1890; approved by the Assistant Secretary of War January 27, 1891; copy sent to Lieut. O. M. Carter, Corps of Engineers, March 3, 1891.

16. *Bridges of Tacoma, Olympia and Grays Harbor Railroad Company across Chehalis River between Aberdeen and Cosmopolis, Washington, and across Johns River near its confluence with Grays Harbor, Washington.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plans and locations submitted by the company November 13, 1890;

approved by the Assistant Secretary of War February 9, 1891; copies sent to Capt. Thomas W. Symons, Corps of Engineers, February 11, 1891.

17. *Bridges of Norfolk and Western Railroad Company across Tug Fork of Big Sandy River, 91 and 95½ miles above Catlettsburg, Kentucky.*—Act approved February 9, 1891.

Plans and locations submitted by the company January 17 and 29, 1891; approved by the Assistant Secretary of War February 13, 1891; copy sent to Maj. D. W. Lockwood, Corps of Engineers, February 18, 1891.

18. *Bridge of Port View Bridge Company across Youghiogheny River at McKeesport, Pennsylvania.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Pennsylvania.

Plan and location submitted by the company November 28, 1890; approved by the Assistant Secretary of War February 26, 1891; copy sent to Lieut. Col. Wm. E. Merrill, Corps of Engineers, February 28, 1881.

19. *Bridge of Inter-State Bridge and Street Railway Compang across Missouri River, between Council Bluffs, Iowa, and East Omaha, Nebraska.*—Act approved February 13, 1891.

Plan and location received from the company February 16, 1891; approved by the Assistant Secretary of War March 5, 1891; copy sent to Lieut. Col. Chas. R. Suter, Corps of Engineers, March 20, 1891.

20. *Bridge of Northern Pacific and Puget Sound Shore Railroad Company across Duwamish (D' Wamish) River near Seattle, Washington.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Washington.

Plan and location submitted by the company November 13, 1890; approved by the Assistant Secretary of War March 6, 1891; copy sent to Capt. Thomas W. Symons, Corps of Engineers, March 9, 1891.

21. *Bridge of Spokane and Palouse Railway Company across Clearwater River, about 11 miles above Lewiston, Idaho.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Idaho.

Plan and location submitted by the company November 13, 1890; approved by the Assistant Secretary of War March 28, 1891; copy sent to Capt. Thomas W. Symons, Corps of Engineers, April 7, 1891.

22. *Bridge of Allegheny Bridge Company across Allegheny River, at Sixth street, Pittsburg, Pennsylvania.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Pennsylvania.

Plan and location submitted by the company March 17, 1891; approved by the Assistant Secretary of War May 2, 1891; copy sent to Lieut. Col. Wm. E. Merrill, Corps of Engineers, May 5, 1891.

23. *Bridge of Messrs. Frederick W. Dickinson, Richard M. Winfield, Frederick P. Forster, and John H. Murphy, across channel separating Little Island from mainland at Osterville, in town of Barnstable, Massachusetts.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Massachusetts.

Plan and location submitted April 18, 1891; approved by the Assistant Secretary of War May 19, 1891; copy sent to Maj. W. R. Livermore, Corps of Engineers, May 20, 1891.

24. *Bridge of city of Winona, Minnesota, across Mississippi River at Winona, Minnesota.*—Act approved September 25, 1890.

Plan and location submitted by the city May 1, 1891; approved by the Assistant Secretary of War June 4, 1891; copy sent to Maj. A. Mackenzie, Corps of Engineers, June 6, 1891.

25. *Bridge of Missouri River and Land Improvement and Construction Company across Missouri River near mouth of Kansas River, between Wyandotte County, Kansas, and Clay County, Missouri.*—Acts approved October 12, 1888, and February 6, 1890.

Plan and location submitted by the company October 12, 1889, not being in conformity with the provisions of the act of October 12, 1888, were not approved. Plans and locations submitted February 7, 1890, and January 24, 1891, were reported upon adversely by the Missouri River Commission, and were not approved. Amended plan and location submitted March 2, 1891; approved by the Assistant Secretary of War June 4, 1891; copy sent to Lieut. Col. Chas. R. Suter, Corps of Engineers, President Missouri River Commission, June 8, 1891.

26. *Bridge of Coos Bay, Roseburg and Eastern Railroad and Navigation Company across Coal Bank Slough, in Coos County, Oregon.*—Act approved March 3, 1891.

Plan and location submitted by the company March 18, 1891; approved by the Acting Secretary of War June 11, 1891; copy sent to Capt. Thomas W. Symons, Corps of Engineers, June 13, 1891.

August 20, 1891, Captain Symons reported the completion of the bridge in practical conformity with the approved plans.

27. *Bridge of St. Clair, Madison and St. Louis Belt Railroad Company across Mississippi River at Alton, Illinois.*—Act approved August 29, 1890.

Plan and location submitted by the company April 8, 1891; approved by the Assistant Secretary of War August 1, 1891, on condition that the opening on each side of pier VII should not be closed until a good channel should be established through the draw and rendered permanent by the action of the Government dike now under construction, the company agreeing to maintain the channel from the lower end of the dike through the draw; copy sent to Maj. A. M. Miller, Corps of Engineers, August 5, 1891.

28. *Temporary and permanent bridges of Chicago and North-Western Railway Company across North Branch of Chicago River near Kinzie Street, Chicago, Illinois.*—Section 7 of the river and harbor act approved September 19, 1890, and ordinance of the Common Council of the city of Chicago.

Plans and location submitted by the company June 25, 1891; approved by the Acting Secretary of War August 3, 1891; copy sent to Capt. W. L. Marshall, Corps of Engineers, August 5, 1891.

29. *Bridge of The Upper Bridge Company across Monongahela River near Pittsburg, Pennsylvania.*—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of Pennsylvania.

Plan and location submitted by the company June 18, 1891, and modified plan submitted July 22, 1891; approved by the Acting Secretary of War August 21, 1891; copy sent to Lieut. Col. Wm. E. Merrill, Corps of Engineers, August 25, 1891.

30. *Bridge of Chicago and North Michigan Railroad Company across Pine Lake near Charlevoix, Michigan.*—Section 7 of the river and harbor act approved September 19, 1890, laws of the State of Michigan, and assent of Board of Supervisors of Charlevoix County, Michigan, to the construction of the proposed bridge.

Plan and location received from the company July 28, 1891; approved by the Acting Secretary of War September 4, 1891; copy sent to Maj. William Ludlow, Corps of Engineers, September 8, 1891.

31. *Bridge of commissioners of public parks of the city of New York*

across Harlem River at 155th street and McComb Dam Road, New York City, to replace the McComb Dam Bridge.—Section 7 of the river and harbor act approved September 19, 1890, and act of the legislature of the State of New York.

Plan and location submitted by the commissioners May 20, 1891; approved by the Acting Secretary of War September 7, 1891; copy sent to Lieut. Col. G. L. Gillespie, Corps of Engineers, September 9, 1891.

BRIDGE OF NORTH RIVER BRIDGE COMPANY ACROSS HUDSON RIVER AT NEW YORK CITY.

Under the provisions of act of Congress approved July 11, 1890, the North River Bridge Company, on December 1, 1890, submitted plan and location for proposed bridge across Hudson River at New York City. The plans were, December 4, 1890, referred to The Board of Engineers for examination and report. Their report, dated April 23, 1891, with the views and recommendations of this office, and the action of the War Department indorsed thereon, is submitted as Appendix B B B 1.

BRIDGES OBSTRUCTING NAVIGATION.

Under the requirements of sections 9 and 10 of the river and harbor act of August 11, 1888, the Secretary of War notified the corporations owning or controlling certain bridges obstructing navigation to so alter the same as to render navigation through or under them free, easy, and unobstructed, and prescribed in each case a reasonable time when such alteration is to be made, as follows:

1. *Bridge across the Ashley River, South Carolina.*—Notice dated August 27, 1890, was served on the president of the New Bridge Company of South Carolina, September 8, 1890, prescribing July 1, 1891, as the time when the required alteration is to be made and completed. The officer in charge of the engineer district in which the bridge is located has reported the alterations made and completed.

2. *Bridge across the Swinomish Slough, Washington.*—Notice dated September 17, 1890, served on the president and on the general manager of the Seattle and Northern Railroad Company at Seattle, Wash., October 17, 1890. Alteration to be made and completed on or before January 1, 1891. Time informally extended to April 1, 1891. The officer in charge of the engineer district in which the bridge is located has reported that the work will probably be completed by October 9, 1891.

The river and harbor act approved September 19, 1890, provides as follows:

SEC. 4. That section nine of the river and harbor act of August eleventh, eighteen hundred and eighty-eight, be amended and reënacted so as to read as follows:

That whenever the Secretary of War shall have good reason to believe that any railroad or other bridge now constructed, or which may hereafter be constructed over any of the navigable water-ways of the United States is an unreasonable obstruction to the free navigation of such waters on account of insufficient height, width of span, or otherwise, or where there is difficulty in passing the draw-opening or the draw-span of such bridge by rafts, steam boats, or other water-craft, it shall be the duty of the said Secretary, first giving the parties reasonable opportunity to be heard, to give notice to the persons or corporations owning or controlling such bridge so to alter the same as to render navigation through or under it reasonably free, easy, and unobstructed; and in giving such notice he shall specify the changes required to be made, and shall prescribe in each case a reasonable time in which to make them. If at the end of such time the alteration has not been made, the Secretary of War shall forthwith notify the United States district attorney for the district in which such

bridge is situated, to the end that the criminal proceedings mentioned in the succeeding section may be taken.

SEC. 5. That section ten of the river and harbor act of August eleventh, eighteen hundred and eighty-eight, be amended and reënacted so as to read as follows:

That if the persons, corporation, or association owning or controlling any railroad or other bridge shall, after receiving notice to that effect as hereinbefore required from the Secretary of War and within the time prescribed by him, willfully fail or refuse to remove the same, or to comply with the lawful order of the Secretary of War in the premises such persons, corporation or association shall be deemed guilty of a misdemeanor and, on conviction thereof, shall be punished by a fine not exceeding five thousand dollars, and every month such persons, corporation, or association shall remain in default in respect to the removal or alteration of such bridge shall be deemed a new offense, and subject the persons, corporation, or association so offending to the penalties above prescribed.

In obedience to the above requirements, the Secretary of War notified the persons, corporations, or associations owning or controlling certain bridges, after giving them a reasonable opportunity to be heard, to so alter said bridges as to render navigation through or under them reasonably free, easy, and unobstructed, specifying in the notice the changes required to be made, and prescribing a reasonable time in which to make them, as follows:

1. *Bridge across Green River (below Lock No. 1) at Spottsville, Kentucky.*—Notice dated October 27, 1890, was served on the president of the Louisville, St. Louis, and Texas Railroad Company at New York City, November 3, 1890. Alteration required: Widening the west draw opening to 160 feet and placing the west pier 52 feet to the west of its present position. Alteration to be made and completed on or before July 31, 1891. Time extended to October 31, 1891.

2. *Bridge across the Muskingum River between Marietta and Harmar, Ohio.*—Notice dated January 22, 1891, served on the vice-president of the Baltimore and Ohio Southwestern Railroad Company at Cincinnati, Ohio, January 24, 1891. Alteration required: The insertion of a draw span in the northeastern end of the bridge opposite the outlet of the ice-harbor lock, with a clear width of opening adjacent to the abutment of 80 feet, as shown on map attached to notice. Alteration to be made and completed on or before October 31, 1891. Time extended to January 1, 1892.

3. *Bridge across the Muskingum River between Taylorsville and Duncan Falls, Ohio.*—Notice dated February 25, 1891, served on the commissioners of Muskingum County, Ohio, at Zanesville, March 3, 1891. Alteration required: The construction of a draw span below Lock No. 9 in accordance with the plan shown on the map accompanying the notice. Alteration to be made and completed on or before September 30, 1891.

4. *Bridge across the canal of the Muskingum River at foot of Main street, Zanesville, Ohio.*—Notice dated February 25, 1891, served on the commissioners of Muskingum County, Zanesville, Ohio, March 3, 1891. Alteration required: The center of the pivot pier to be 29 feet east of its present position, the minimum length of the longer arm of the draw span to be 69 feet, and the western shore of the canal to be extended so as to reach the end of the draw when closed, said alterations being shown upon the map attached to the notice, and permitting of the outlines of the canal being made to conform to the curves marked on said map. Alteration to be made and completed on or before December 1, 1891. April 9, 1891, the Secretary of War extended the time to December 1, 1892, to be then further extended or abandoned if Government work of constructing Lock and Dam No. 11 be not commenced.

5. *Bridge across the Bayou Plaquemine, Louisiana.*—Notice dated

March 3, 1891, served on the president of Texas and Pacific Railway Company at New York City, May 4, 1891. Alteration required: Modification of the bridge by the insertion of a draw span having a clear opening of 75 feet in width, the pivot pier of the draw to be located on the northern margin of the channel. Alteration to be made and completed on or before April 15, 1892.

6. *Bridge across the channel leading to Back Cove, Portland Harbor, Maine.*—Notice dated March 20, 1891, was served on the agent at Portland, Me., of the Grand Trunk Railway Company of Canada, March 24, 1891. Alteration required: Modification of the draw span so as to afford a clear width of opening of 75 feet; modification of the east and west ends of the draw pier, and construction of approaches to the draw in the nature of guard pier, dolphins, etc., all as shown on map attached to the notice. Alteration to be made and completed on or before January 1, 1892.

7. *Bridge across the Savannah River below Augusta, Georgia.*—Notice, dated March 20, 1891, served on the president of the Port Royal and Augusta Railway Company, at Savannah, Ga., March 23, 1891. Alteration required: (1) A method of locking the draw span in place when open. (2) Groups of fender piling or a rest pier for the open draw, to prevent steamboats by high winds or cross currents being drifted against the open bridge or the piers. Alteration to be made and completed on or before November 1, 1891.

8. *Bridge across the Tennessee River at Florence, Alabama.*—Notice, dated April 22, 1891, served on the president of the East Tennessee, Virginia and Georgia Railway Company, at New York City, April 25, 1891. Alteration required: (1) Removing the old pier in the North Channel of the draw, the removal to be complete to the bottom of the river, including all surrounding crib work or riprap. (2) Removing completely the two piers from the South Channel. (3) Removing the southeast corner of north abutment 7 feet back and 7 feet on face, as shown on drawing attached to the notice. Alteration to be made and completed on or before September 1, 1891.

Alteration has been made and completed.

9. *Bridge across the Little Tennessee River near Nile's Ferry, Tennessee.*—Notice, dated May 20, 1891, served on the receiver of the Marietta and North Georgia Railway Company, at Marietta, Ga., May 27, 1891. Alteration required: Raising one span of the bridge 23 feet above its present height; forming one navigation span with a clear height of 56 feet above low water and with a clear width between piers of 130 feet, as shown on the map attached to the notice. Alteration to be made and completed on or before January 1, 1892.

10. *Bridge across Spuyten Duyvil Creek, New York.*—Notice, dated June 9, 1891, served on the general manager (in the absence of the president) of the New York Central and Hudson River Railroad Company, at New York City, June 13, 1891. Alteration required (mutually agreed upon by the parties in interest as a temporary measure to meet the necessities of the existing navigation): Enlargement of the draw opening so as to afford a clear opening of not less than 50 feet in width, as shown on plan attached to notice; a new line of piles to act as a guide through the draw opening, and the maneuvering of the draw by a steam motor. Alteration to be made on or before December 1, 1891.

11. *Bridge across Trout Creek, Florida.*—Notice, dated July 2, 1891, served on the general manager of the Florida Central and Peninsular Railroad Company, at Jacksonville, Fla., July 7, 1891. Alteration re-

quired: Removing the piles from the water way of the draw span, and arranging the span so as to permit it to be opened for the passage of steamboats and other water craft. Alteration to be made and completed on or before July 20, 1891.

Alteration has been made and completed.

12. *Bridge across the Chicago River at Canal street, Chicago, Illinois.*—Notice, dated August 5, 1891, served on the mayor of the city of Chicago, Ill., September 5, 1891. Alterations required: To remove the present pivot pier, the protecting wings or bridge rests, and all other adjuncts to said pivot pier now in the stream and obstructing navigation, and to so reconstruct said pivot pier and to so alter and change the said bridge and the draw as to give a clear opening of 60 feet in width for the passage of vessels on each side of said pivot pier.

The present pivot pier, the protecting wings or bridge rests, and all other adjunts to said pivot pier now in the stream and obstructing navigation to be removed within 3 weeks of the date (September 5, 1891) of the service of this notice.

The said pivot pier to be reconstructed and the said bridge and the draw to be altered and changed, as described above, on or before the 1st day of May 1892.

(See report of Board of Engineers, Appendix B B B 2.)

13. *Bridge across the Kentucky River at Frankfort, Kentucky.*—Notice, dated August 28, 1891, served on the president of the Louisville and Nashville Railroad Company, at Louisville, Ky., September 14, 1891. Alteration required: To raise the said bridge 10 feet, so as to make its clear height above the normal level of pool 4 of the Kentucky River 48 feet and 4 inches. Alteration to be made and completed on or before September 1, 1892.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

Under the requirements of section 2 of the river and harbor act approved July 5, 1884, and section 4 of the river and harbor act approved August 5, 1886, there are submitted herewith reports of officers in charge of river and harbor districts of instances in which piers, breakwaters, or other works built by the United States in aid of commerce or navigation are used, occupied, or injured by corporations or individuals.

(See Appendix C C C.)

MISCELLANEOUS.

[Public works not provided for in acts making appropriations for the construction, repair, and preservation of works on rivers and harbors.]

MAINTENANCE AND REPAIR OF WASHINGTON AQUEDUCT—WATER SUPPLY, DISTRICT OF COLUMBIA, ACT MARCH 2, 1889—INCREASING THE WATER SUPPLY OF WASHINGTON, D. C.—ERECTION OF FISHWAYS AT THE GREAT FALLS OF THE POTOMAC.

Officer in charge, Lieut. Col. George H. Eliot, Corps of Engineers.

1. *Washington Aqueduct.*—The work of repairing the damage to the dam at Great Falls, done in the great flood of June 2, 1889, was completed early in the year. The flood carried away the 15-inch coping course and part of the next lower course from a total length of 1,103

feet, or 347 feet from the dam across the Maryland Channel and 756 feet from the dam across the Virginia Channel. The work of repair commenced June 6, 1889, and, as the condition of the river would allow (except after the end of the last fiscal year while waiting for the new appropriation), it was steadily and energetically carried on. The cost of repair was about $9,000. Early in July the officer in charge found that he was not able to keep the water in the distributing reservoir up to its proper height, and it was evident that there was something wrong in the conduit, either in the feeder at its head or in one of the numerous tunnels along its route. He had an examination made at the former place, and, the river being exceptionally low, there was head room in the conduit sufficient to enable the watchman to pass through it in a boat lowered down to the water in the gate-house from the gate-house to the inlet from the river. It was found to be half full of deposits (logs, stumps, gravel, and mud), that must have gotten in in the flood just mentioned. Work of cleaning out the feeder of the conduit was started at 10 o'clock a. m. on the 21st of July and carried on with a force of 32 men without stopping until its completion at noon of the 22d. While the water was drawn from the conduit the officer in charge had the conduit carefully inspected from the gate house to culvert No. 2, a distance of 9,300 feet. From 6 inches to 8 inches of sediment was found at the bottom of the conduit, but no obstruction except a telegraph pole about 20 feet long, which was found in the waste-weir No. 1. This and the débris found in the feeder to the conduit were doubtless drawn in from the river during the flood of 1889, and they show the danger to which the head of the conduit is subject in such floods. On the 12th of September, when the water was turned on the 12-inch main between the reservoir and Foundry Branch, which main had been used as a drain during the construction of the 48 inch auxiliary connection, there was found to be almost a complete stoppage of the flow between the reservoir and Foundry Branch. On making an examination of the main, there were found to be some small obstructions just above the blow-off at Foundry Branch, which were removed, but their removal did not relieve the main. Repeated emptyings and fillings of the main and every expedient that could be thought of were used to locate and remove the difficulty, but it was December before the full flow of the main could be obtained. The numerous trees growing over and near the conduit between Great Falls and the receiving reservoir, especially between the former and the "Club House," endangered the conduit by the penetration of their roots into the joints of the arch, and they were all cut down, the trunks of such as were suitable being saved for posts for use in fencing the aqueduct lands. A brick storehouse 40 feet by 20 feet in area has been constructed at the distributing reservoir for the storage of tools and materials for repairs on that division of the aqueduct, and it is proposed during the next fiscal year to erect a similar one at Great Falls for the upper division. The old office building at the receiving reservoir has been put in repair to serve the same purpose on the receiving reservoir division. Strong guard fences have been built on the sides of the conduit road at the dam at the receiving reservoir and at the high embankments at the culverts and other places between the distributing reservoir and the receiving reservoir. These were made necessary by the great increase of travel on the conduit road and the danger of accidents, especially at night. Four thousand two hundred and sixty-six feet of these fences was built during the fiscal year, and it is proposed during the next fiscal year, as funds will allow, to protect the embankments farther up the line. The road between the

"Club House" and Great Falls, which is the only route of communication with the falls, and is almost impassable in winter, was macadamized for a length of 1,548 feet and a width of 10 feet on the worst portion of the road, and it is hoped to improve more of it during the next fiscal year. A new "curtain" screen for the screen-house at the distributing reservoir was completed during the year. In August a survey was made of the land owned by the United States between Foundry Branch and the distributing reservoir. There were found to be several cases where parties owning the adjoining land have built fences on the lands of the United States and several cases where private improvements were found to encroach on these lands. Authority has been given the officer in charge to employ the District surveyor to make an accurate survey of the lands surrounding the receiving reservoir. The survey has been completed and the lines will be permanently marked. During the next fiscal year it is proposed to continue the surveys of the lines of the aqueduct lands and to place boundary stones at all the angles where they are missing. With the approval of the Secretary of War, there have been turned over to the Commissioners of the District of Columbia, for care and maintenance, 131 valves which were placed on the outlets from the 48-inch main and the connecting mains recently laid under the act of March 2, 1889, for controlling the supply of water from these mains to the District's distributing mains. The other valves on the former mains, 98 in number, in addition to the valves on the old mains, remain under the care of the officer in charge of the aqueduct. A contract has been made for the delivery of 5 iron-pillar cranes for handling the stop timbers on the line of the aqueduct. The opening from conduit tunnel No. 1 at waste-weir No. 1, near the head of the conduit, one of the most important of the waste-weirs, is exposed to an inflow from the river in great floods like that of June, 1889, when the river rose 75 feet at this point, and to an indraft of logs and other drift wood, which endangers the conduit and the supply of water in the city. It was intended to make the required repairs and alterations at this place during the last fiscal year; but, as it is impossible to get materials for the purpose to the weir except by the Chesapeake and Ohio Canal, the work has been postponed until the next fiscal year, when it is expected the canal will again be in operation. There is a leak in the conduit at the upper end of Cabin John Bridge, the repair of which will also have to be postponed until the repairs of the canal are completed. In order to repair the leak the conduit will have to be emptied the entire distance from Great Falls to the receiving reservoir, and it is proposed at the time of the repair to take advantage of the opportunity and have the interior of the conduit inspected from one end to the other. The tar pavement of the roadway over Cabin John Bridge is badly worn, and it is proposed to repave the bridge with granite blocks. The officer in charge recently obtained the details of a patented device for tapping, with taps up to 12 inches in diameter, large mains under pressure; that is, the shutting off of the water, which is always a source of anxiety on account of the danger in case of fire in the district supplied by the main, can be avoided when the main is tapped. In the report for the last fiscal year mention was made of a great deficiency of air-valves and blow-offs on the old mains, which it is hoped to supply during the next fiscal year by the use of this device.

In the act of August 6, 1890, making appropriations for the Washington Aqueduct, the sum of $4,000 was appropriated for the purchase of 5 acres of land near the distributing reservoir, and $1,500 was appropriated for the improvement of this land, but by reason of a rise in the

asking prices of land in the vicinity the trustees of the owners would not sell the piece desired for less than $3,000 an acre, or $15,000 for the whole, and a resort to condemnation was, under the circumstances, not deemed advisable. Fortunately the Drover's Rest cattle market has been discontinued and all of the buildings and fences have been removed, so that the necessity of the purchase no longer exists, although it would be desirable for the United States to own the entire frontage on the northerly side of the conduit road opposite the distributing reservoir. There have been no breaks or any serious leaks in any of the mains during the last fiscal year. The bank of Rock Creek was wearing so much under the action of the 20-inch blow-off from the 48-inch main which passes out through the west wing wall of the M street highway bridge, that it would endanger the foundation of the wall, and a large flume of lumber was constructed to carry the outflow from the blow-off to the creek. It serves the purpose temporarily, but it will be necessary to extend the pipe outlet from the blow-off to the edge of the creek, and it is proposed to do this in the next fiscal year. The construction of the cable railway of the Washington and Georgetown Railway Company on M street, Georgetown, has made it necessary to remove the arches of two of the three valve chambers which occupy nearly the full width of the street between Twenty-ninth and Thirtieth streets, and replace them by I beams and arches of small span and rise. The work has been done at the expense of the railway company under supervision of the officer in charge of the aqueduct.

Last year, when the water in the river was at its low stage, or between 6 inches and 1 foot over the dam at Great Falls (which it was for several months), it was found that the water in the distributing reservoir could not be kept up to its proper height of 146 feet above datum. The same is found this year, and that when the water in the distributing reservoir is lowered about 2½ feet during each of the monthly measurements of the consumption and waste of water in the city, it requires about 4 days to get the water in the reservoir back again to its height. The reason of this is that *the height of the dam at Great Falls is not sufficient at low stages of the river to keep the conduit full at its head, or to enable it to deliver as much water as is now consumed and wasted in the city, and at the same time to keep up the head in the mains at the distributing reservoir to* 146 *feet above datum, which is necessary for the supply by gravity of the high northern portions of the city and of Capitol Hill.* The only remedy for this (and it is one that should be made before any further steps are taken for increasing the supply from the distributing reservoir to the city) is the raising of the dam at Great Falls nearly if not quite 2½ feet, or to the height of 150½ feet above datum. During the past year, in addition to the work that has been specifically mentioned, the usual operations for maintaining and preserving the aqueduct have been carried on, and much other work, of which the details will be found in the report of the officer in charge, has been done.

In the table appended to the report of the officer in charge will be found the details of the measurements of water consumed and wasted in the 24 hours ending June 25, 1891, the monthly measurements during the last fiscal year, and the annual measurements in June of each year from 1874 to 1891, both inclusive. The average consumption and waste per diem is 36,588,629 gallons, or about 1,000,000 gallons more than the measurement in 1890, which was taken soon after the 48-inch main was completed and put in operation. The average annual increase before the introduction of the 48-inch main (or from 1874 to 1889) was

about 677,000 gallons. From the result of the census of 1890 very close calculations of the consumption and waste of water per capita have been made, taking first the area actually supplied with Potomac water, and also the entire population of the cities of Washington and Georgetown. The results and a comparison with former census years will be found in the report of the officer in charge.

Attention is invited to the remarks of the officer in charge respecting the necessity of appropriation for the additional works required for restoring to use the receiving reservoir for the double purpose of improving the quality of our Potomac water by relieving it of the muddiness that it has in winter and spring, and of regaining the storage capacity that was lost when this important reservoir, which has a capacity of about 175,000,000 gallons, was thrown out of service by reason of the pollution by some small streams that lead into it; for the further improvement of the quality of the Potomac water by lowering the height of the cross dam at the distributing reservoir; for the protection of the inlet to the aqueduct at Great Falls; for extending an important waste-weir, which is liable to be obstructed by the private owners of adjacent land; for cleaning out the distributing reservoir, and for the purchase or condemnation of a site for a storage yard for supplies for use in case of breaks in mains. These objects and the desired general provision of law relating to appropriations for the Washington Aqueduct are of great importance, and the recommendations of the officer in charge in respect to them are concurred in. Attention is also invited to the remarks of the officer in charge respecting the necessity that will soon arise of raising the height of the dam at Great Falls to meet the growing demands on the aqueduct.

The following is a money statement for the fiscal year ending June 30, 1891:

July 1, 1890, balance unexpended		$3,083.26
Amount appropriated by act approved August 6, 1890		25,500.00
Amount appropriated by act approved March 3, 1891		20,000.00
		48,583.26
June 30, 1891, amount expended during fiscal year		19,139.01
July 1, 1891, balance unexpended		29,444.25
July 1, 1891, outstanding liabilities	$1,434.25	
July 1, 1891, amount covered by uncompleted contract	2,510.00	
Amount of appropriation of August 6, 1890, to be reverted to the Treasury	5,500.00	
		9,444.25
July 1, 1891, balance available		20,000.00

The estimate of the officer in charge for the fiscal year ending June 30, 1892, are as follows:

For improving the quality of the Potomac water and restoring the capacity for its storage, by improving the receiving reservoir, including the purchase or condemnation of the necessary land	$290,625
For further improving the quality of the Potomac water by lowering the height of the cross dam at the distributing reservoir	12,500
For protecting the inlet to the aqueduct at Great Falls	5,000
For extending the outlet of waste-weir No. 3	2,500
For purchase or condemnation of a site for a storage yard	10,000
For cleaning out the distributing reservoir	13,825
For maintenance and repairs of the aqueduct and the reservoirs, mains, roads, etc., connected therewith	21,000
	355,450

(See Appendix D D D 1.)

2. *Water supply, District of Columbia; the 48-inch main.*—The work of laying the 48-inch main for which $575,000 was appropriated by the act of March 2, 1889, and the laying of the 30-inch main on Capitol Hill, which was done by means of the same appropriation, were completed in the fiscal year 1889–'90. With the amount that remained of the appropriation, and as a remedy for the loss of head in the high area in the vicinity of M, N, and O streets, northwest, between Tenth and Thirteenth streets, arising from the small sizes and bad condition of the District's street mains, it was decided to lay a 24-inch main in Eleventh street, northwest, between K and U streets, and, for a similar reason, and looking to the future of Capitol Hill, it was decided to lay a new 30-inch main in New Jersey avenue between B and L streets. Contracts were made early in the last fiscal year for the materials for both of these mains, and on the 3d of October, 1890, sufficient of the pipe and special castings had been received to warrant the commencement of laying the Eleventh street main, which was steadily carried on until its completion on the 14th of November. It is 5,142 feet, or about 1 mile, long. It connects at K street with the 30-inch main, at Massachusetts avenue with the 36-inch main, at R street with the 48-inch main, and at U street with a 12-inch District main. The supply to the main is from the 48-inch main at R street. The gain in pressures in the vicinity of the main was very marked, as will be observed in the table appended to the report of the officer in charge, showing the pressures in pounds and the head in feet on Tenth, Eleventh, and Twelfth streets before and after the completion of the main. A plat of the main, showing the positions of its connections, main valves, air valves, and blow-off valves, will also be found with the report of the officer in charge.

The work of laying the new 30-inch main in New Jersey avenue, was commenced on the 14th of November, 1890, and finished on the 16th of January, 1891. It is 4,410 feet, or rather more than three-fourths of a mile long. It connects at L street with the 48-inch main and at B street with both the old 30-inch main in B street and the new 30-inch main leading through the Capitol Grounds and East Capitol street to Eleventh street, east. This main being entirely for the benefit of Capitol Hill, no connections were made with the District's distribution system anywhere on its route. The gain in pressures on Capitol Hill by the construction of this main is shown in a table which, with a plat of the route of the main, accompanies the report of the officer in charge.

When the Eleventh street main and the New Jersey avenue main just mentioned had been completed, it was decided, as there yet remained of the appropriation sufficient money for the purpose, to lay a 24-inch main in K street northeast, extending as far as Eleventh street. This was done for the purpose of increasing the supply to northeast Washington, which is rapidly increasing in population, and at the earnest solicitation of the District government. The necessary contracts were entered into, and the work of laying the main, which commenced on the 24th of April, 1891, was completed on the 13th of June. It is 6,760 feet, or about $1\frac{1}{4}$ miles, long, and is supplied through the by-pass at New Jersey avenue and L street from the 36-inch main. A table showing the pressures in the vicinity of the main before and after its completion and a plat of its route will be found with the report of the officer in charge.

In addition to the foregoing, there was completed early in the last fiscal year the following work connected with the 48-inch main that remained to be done at the beginning of the year, viz: Filling over the 48-inch connection with the auxiliary gate-house and by-conduit at the

distributing reservoir; the construction of the masonry well for the stop timbers for controlling this connection; the completion of the laying of the new service pipes in M street, Georgetown, between Twenty-Ninth and Thirtieth streets, to enable the service pipes connected with the 12-inch main, which endangered the foundation of the 48-inch main, to be cut off; and the rebuilding on the canal road of the portion of the wall of the Chesapeake and Ohio Canal which fell under the weight of the 48-inch pipes deposited on the side of the road before they were laid in the trench.

The following table shows the locations and lengths of mains laid by means of the act of March 2, 1889, providing for the construction of the 48-inch main, and the total length of these mains, viz, 45,293 feet, or about 8½ miles:

Size of main.	Location.		Length.
		Feet.	*Feet.*
48-inch...	From the distributing reservoir to Fourth street northwest		22,888
30-inch..	East Capital street	5,695	
30-inch...	New Jersey avenue northwest	4,410	
24-inch...	Eleventh street northwest	5,142	22,405
24-inch...	K street northeast	6,760	
24-inch...	Eighteenth street, between K and L streets, northwest	398	
	Total		45,293

A table showing the details of the expenditure of the appropriation will be found in the report of the officer in charge.

There remains of the appropriation the sum of $10,669.91 that can be reverted to the Treasury to the credit of the surplus fund.

The following is a money statement for the fiscal year ending June 30, 1891:

July 1, 1890, balance unexpended	$125,387.65
June 30, 1891, amount expended during fiscal year	114,521.07
July 1, 1891, balance unexpended	10,866.58
July 1, 1891, outstanding liabilities	196.67
July 1, 1891, balance available	10,669.91

No estimate for further appropriation is submitted.

(See Appendix D D D 2.)

3. *Increasing the water supply of Washington, D. C.*—This work was commenced under an appropriation made in the act of Congress approved July 15, 1882.

All operations on this project are suspended, and no work has been done under it during the year.

The timber lining of the Foundry Branch shaft, which had become decayed, gave way last fall during a rainy period to a depth of about 30 feet below the surface of the ground (or to the point where the shaft entered the rock), and the broken timber and supported earth fell to the bottom of the shaft, filling it to an unknown depth. The falling of the lining at this shaft led to an examination of all the other shafts except Rock Creek shaft, and it was found that the upper part of the lining of each of them should be renewed for the purpose of preventing damage to the shafts as at Foundry Branch. Rock Creek shaft is, and has been for a long time, filled with water, so that it is probable that the timbering in it has not decayed. The work of renewing the lining, which could not be done in winter when the ground around the shafts

was saturated with water on account of the danger of slips, was commenced in March, and has been prosecuted as fast as the weather would allow till the end of the fiscal year, when the lining of the Foundry Branch shaft had been completed and the one at Champlain avenue had been nearly completed. The work consisted in making an entirely new lining of the best quality of Georgia pine, either from the surface of the rock or from the top of the brick lining, that had been carried at the west shaft near the distributing reservoir to a depth of about 10 feet, and at the Howard University shaft to a depth of about 23 feet below the surface of the ground. The lining of the Foundry Branch and Champlain avenue shafts is entirely of wood. It is expected that the work at all the shafts, except Rock Creek shaft, which, as before stated, is filled with water, will be entirely completed early in this fiscal year.

A watchman has been employed during the year at the new reservoir, and, it being found that the piles of stone at the mouths of the shafts which have a market value and should be reserved for the use of the United States and the District of Columbia for the repairs of roads, was being depredated upon by contractors for private work, his duties have included the guarding of the stone at the mouths of all the shafts except the one at Foundry Branch, which is under the care of the watchman at the distributing reservoir.

The following is a money statement for the fiscal year ending June 30, 1891:

July 1, 1890, balance unexpended on all items of appropriation	$436,608.54
June 30, 1891, amount expended during fiscal year	2,816.07
July 1, 1891, balance unexpended	433,792.47
July 1, 1891, outstanding liabilities	1,331.82
July 1, 1891, balance available	432,460.65

No estimate for further appropriation is submitted.

(See Appendix D D D 3.)

4. *Erection of fishways at Great Falls.*—Plans and specifications for a new system of fishways, the first of which is to be erected at Great Falls, having been prepared by theCommissioner of Fish and Fisheries, as contemplated by the act making appropriations for the fishways, proposals for their construction, which had been extensively advertised for, were opened on the 1st of June, 1891. Mr. Isaac H. Hathaway, of Philadelphia, Pa., was the only bidder, and a contract, which is to be finished on or before the 12th of November, 1891, was entered into with him on the 9th of the same month. By direction of the Secretary of War, the construction will be carried on under the direction of the commissioner above mentioned, the engineer officer in charge being held responsible only for the proper protection of the aqueduct dam at Great Falls and for the disbursement of the funds appropriated. The only expenditures during the year were for advertising and the printing of the plans and specifications.

The following is a money statement for the fiscal year ending June 30, 1891:

July 1, 1890, balance unexpended	$30,020.32
July 30, 1891, amount expended during fiscal year	146.14
July 1, 1891, balance unexpended	29,874.18
July 1, 1891, amount covered by uncompleted contract (about)	28,520.32
July 1, 1891, balance available	1,353.86

The Commissioner of Fish and Fisheries is of the opinion that in addition to the funds available the sum of $15,000 will be required to complete the fishways at Great Falls, and an estimate for an appropriation of this amount is submitted.

(See Appendix D D D 4.)

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS, AND CARE AND MAINTENANCE OF THE WASHINGTON MONUMENT, IN THE DISTRICT OF COLUMBIA.

Officer in charge, Col. O. H. Ernst, major, Corps of Engineers.

The various improved parks and reservations have received the care and attention required to maintain them in good condition.

The Washington Monument received necessary attention, and the improvement of the surrounding grounds was continued as far as available funds would permit. The rough grading of the low ground north of the monument was nearly completed, additional roadway surface was constructed, and footwalks laid. There were 159,160 visitors to the top of the shaft during the year, making a total of 456,305 persons who have made the ascent since the monument was opened to the public in October, 1888.

Additional buildings were erected in the nursery grounds. About 402,000 plants were propagated in the greenhouses during the year, nearly all of which were set out in the public grounds in May and June.

In the Smithsonian Grounds additional asphalt road pavement and footwalks, and in Henry (Armory) Park additional asphalt footwalk were constructed.

Reservation No. 162, at the intersection of Ohio avenue with Fourteenth and C streets, northwest, was, by authority of the act of Congress approved December 15, 1890 (vol. 26, Statutes, page 690) transferred to the Commissioners of the District of Columbia as a site for a truck house.

The Commissioners of the District of Columbia having, pursuant to a provision in the District of Columbia appropriation act approved March 2, 1889 (vol. 25, Statutes, page 798), established a circle at the intersection of New Hampshire avenue, Sixteenth and U streets, northwest, to be called "Hancock Circle," it was transferred by them in December, 1890, to the charge of the Office of Public Buildings and Grounds as belonging to one of the classes of reservations under the jurisdiction of that office.

Iowa Circle was entirely remodeled, and new asphalt walks placed throughout.

Reservation No. 158, at the intersection of New York avenue, First and M streets, northwest, was improved by being graded, planted with young trees and shrubs, and inclosed with an iron post-and-chain fence.

Additional progress has been made in the improvement of Judiciary Square and reservation 17 (Garfield Park), and in the park first named asphalt road pavement and asphalt footwalks were constructed.

The statue to the memory of General Lafayette and his compatriots was erected upon the new site selected at the southeast corner of Lafayette Square. The work of constructing the foundation, placing the granite base thereon, and rearranging the grounds was performed by the officer in charge of public building and grounds while the erection of the marble pedestal and the bronze figures was done by the contractors in accordance with the terms of the contract.

The exterior of the Executive Mansion was repainted, some of the apartments redecorated, new carpets and window draperies purchased, some of the furniture renovated, new tile floors laid in the kitchens and upon the south portico, and a system of wires and lamps for electric lights introduced.

Attention is invited to the detailed report of the officer in charge and to his estimates for the coming fiscal year, as follows:

For improvement and care of public buildings and grounds		$171,722
For compensation of persons employed on public buildings and grounds		55,680
For replacing the overhead system of telegraph wires with duplicate six-conductor underground cable, and for care and repair of existing lines		32,500
For contingent and incidental expenses of public buildings and grounds		500
For care of Washington Monument and maintenance of elevator:		
Salaries of employés	$9,060	
Fuel, light, contingencies, etc	3,600	
		12,660
		273,062

(See Appendix E E E.)

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

A survey at Marquette Harbor, Mich., was ordered during the year. The field work was done in January and March under the direction of Capt. Walter L. Fisk, Corps of Engineers, and the plate will be corrected as soon as practicable.

(See Appendix F F F 1.)

PRINTING AND DISTRIBUTION OF CHARTS OF THE NORTHERN AND NORTHWESTERN LAKES.

Under the supervision of this office additions have been made to the engraved copperplates of charts of—

Lake Superior, Nos. 1, 2, and 3;
River St. Marie, No. 1;
Straits of Mackinac;
North end of Lake Michigan;
South end of Lake Michigan;
Beaver Island Group, Lake Michigan;
North end of Green Bay;
South end of Green Bay;
Lake Michigan coast charts Nos. 1, 4, and 8;
Lake Huron;
Detroit River;
Grand and Little Traverse bays, Lake Michigan.

Corrections and additions to quite a number of the other plates have been ordered, and work thereon is progressing.

During the year 6,477 charts were issued under the supervision of Col. O. M. Poe, Corps of Engineers, 599 of which were sold at 30 cents each, 5,339 at 20 cents each, and 39 at 10 cents each, and the amount of $1,251.40 turned into the Treasury. In addition, 47 charts at 20 cents each and 2 at 10 cents each, aggregating 49 charts, were sold at this office, and the sum of $9.60 was deposited in the Treasury. The total amount received for the sale of charts was, therefore, $1,261. The total appropriation for printing and distribution of these charts was $2,000 only, so that the actual charge to the Treasury for the issue of about 6,500 charts was less than $800.

If it were not for the fact that the distribution is made from an office already organized for river and harbor work, the necessary supply of

charts could not be printed and distributed, the sum appropriated for the purpose being as low as $2,000. The supply of paper is reduced, and complaint has been made of the quality of that on which the charts are printed. This material is not as expensive as other chart papers, and a better article could be furnished if more funds were available. It is therefore recommended that the amount appropriated for printing and issuing charts to navigators and electrotyping plates for chart-printing be increased to $3,000, as is estimated for.

Attention is earnestly invited to the fact that the draft and size of the vessels carrying the commerce of the lakes has considerably increased in the last few years, and will again be increased when the new lock in St. Marys River, now under construction; is completed. Localities deemed perfectly safe for navigation when the maximum draft of vessels was 12 feet are regarded with suspicion when the draft is one-half or more greater. Consequently certain special areas should be reëxamined for the benefit of the enormous commerce now upon the lakes.

The levels of the lakes are subject to considerable fluctuations in the course of a season as well as from one season to another. Lake Ontario, between the highest and the lowest recorded, has fluctuated nearly or quite 5 feet, Lake Erie quite 4 feet, Lakes Huron and Michigan nearly 5 feet, and Lake Superior about 4½ feet. Charts when drawn and engraved are made to show depths below some plane assumed for the chart, and can not change for the temporary fluctuation of the water surface. Referring for illustration to Lakes Huron and Michigan, the lowest water for the season has been decreasing for the successive years, and almost uniformly, from 1885 to 1891, inclusive, a period of seven seasons, and in 1891 has reached the lowest point since 1873. In that period of seven seasons there has been a considerable advance in the size of lake craft, which, combined with the much lower stage and the consequent lesser depth, has made navigation insecure where formerly no difficulty was met with.

In due course the lakes will again rise and difficulties will diminish. Still, certain special reëxaminations should be made, and, in view of the importance of the subject and the enormous tonnage on the lakes, an appropriation of $50,000 for "surveys, additions to, and correcting engraved plates" is earnestly recommended. These reëxaminations can be made in the most economical and expeditious manner, because of the organized districts in connection with river and harbor work now at the chief cities on the lakes. The records of the former survey, triangulation data, etc., are now in this office, and every use will be made of them to prevent the duplication of work.

Steps have been taken with the means on hand to add to the number of coast charts now published for Lakes Huron and Superior, and surveys have been ordered at localities on Lakes Erie and Ontario. Any obstructions discovered during the year will be located so far as funds will allow.

Printing and issuing charts.

Amount appropriated by act of August 30, 1890	$2,000.00
June 30, 1891, amount expended during fiscal year	1,684.68
July 1, 1891, balance unexpended	315.32
July 1, 1891, outstanding liabilities	313.97
July 1, 1891, balance	1.35
Amount that can be profitably expended in fiscal year ending June 30, 1893	3,000.00

Surveys, additions to, and correcting engraved plates.

Amount appropriated by act of August 30, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	200.00
July 1, 1891, balance	9,800.00
Amount that can be profitably expended during fiscal year ending June 30, 1893	50,000.00

(See Appendix F F F 2.)

CONSTRUCTION AND IMPROVEMENT OF ROADS AND BRIDGES IN YELLOWSTONE NATIONAL PARK.

Officer in charge, Maj. William A. Jones, Corps of Engineers; Lieut. William E. Craighill, Corps of Engineers, until May 12, 1891, and Lieut. Hiram M. Chittenden, Corps of Engineers, since June 5, 1891, under immediate orders of the officer in charge. Division Engineer, Col. O. M. Poe, Corps of Engineers.

The construction of roads and bridges in the Yellowstone National Park was commenced in a systematic manner in 1883, when the direction of the work was placed in the hands of an officer of the Corps of Engineers. A number of small appropriations had been expended in the endeavor to make it possible to reach the main objects of interest; access was rendered possible, but only after a tiresome trip, attended with considerable danger. Since 1883 the work has remained in the charge of the Engineer Department.

At the outset the engineers adopted a project which has since been followed. It embraces a belt line road, commencing at Gardiner, on the north boundary line of the park; thence to Mammoth Hot Springs; thence to Upper Geyser Basin, via Norris Geyser and Lower Geyser Basins; thence to the outlet of Yellowstone Lake, via Shoshone Lake and the west arm of Yellowstone Lake, crossing the continental divide of the Rocky Mountains twice; thence to Yancey, via the Falls and Grand Cañon of the Yellowstone River; thence to Mammoth Hot Springs, completing a circuit of about 145 miles. There are also included in the project a road from the west boundary-line of the park to intersect the road along the Yellowstone River between the lake outlet and the Falls via Lower Geyser Basin; a road from Norris Geyser Basin to the Falls of the Yellowstone; a road from Yancey to the east line of the park, and short branch roads to points of interest, comprising in all about 225 miles of new roads with necessary bridges and culverts. Estimated costs as revised in 1889, $444,779.42.

The act of Congress approved March 3, 1891, changed the project of the part of the belt line between Lower Geyser Basin and Yellowstone Lake, by requiring the road to be built "by the shortest practicable route" from Fountain Geyser to the thumb of Yellowstone Lake. This change will not materially affect the cost.

At the beginning of the year 62.85 miles of new roads had been constructed, which, in connection with parts of old roads kept in condition, enabled tourists to visit Mammoth Hot Springs, Norris Geyser Basin, Lower Geyser Basin, and Upper Geyser Basin, and the Falls and upper end of the Grand Cañon of the Yellowstone River. A commencement had been made toward opening up the Shoshone and Yellowstone Lakes regions to travelers.

Total amount expended upon the project since commencement of work in 1883 to June 30, 1890, including outstanding liabilities, $184,779.42.

The appropriation of August 30, 1890, became available too late to permit of construction work last fall. Repair parties were put into the field, however. They succeeded in repairing 58½ miles of roads, together with the bridges and culverts. This work placed the roads in the park in good condition for the ensuing year and made it possible to direct all operations in the spring toward the construction of new roads.

The act of August 30, 1890, requiring that not less than $50,000 of the appropriation be expended under contract, necessitated a survey. By energetic action the survey was made in October and November. Proposals for the construction of the roads, after due advertisement, were opened April 25, 1891. Contracts were entered into May 16, with Wyatt & Scott, for 7.5 miles and William Z. Partello, for 20.3 miles.

Field operations were resumed in the spring, at as early a date as possible. A location for a road following "the shortest practicable route" from the thumb of the Yellowstone Lake to Fountain Geyser was explored, and its construction commenced, as required by the act of March 3, 1891. Messrs. Wyatt & Scott have begun work on their contract.

Unusual rains the past spring have temporarily allayed the dust nuisance. The officer in charge is prepared to suppress this annoyance to travelers when dry weather sets in.

It is proposed, during the present working season, to build the road from the Geyser Basin to Yellowstone Lake, and thence along the lake shore and river to the Grand Cañon, in all about 50 miles in length, and possibly to build a part of the unfinished road between Gibbon Cañon and Lower Firehole Basin.

During the next season it is proposed to do as much work on the road between Grand Cañon, Yancey, and Mammoth Hot Springs as the sum that may be appropriated will accomplish. It is estimated that the sum of $150,000 can be profitably expended.

The estimates of "amount required for existing project," which are annually submitted, only apply to the construction of new road. They do not cover current repairs and maintenance. These items will amount to $12,000 in the season of 1891, and will be proportionately increased with the addition of new road.

Attention is again invited to the advisability of making appropriations for this work, as for rivers and harbors, without a time limit, the money to be expended under the direction of the Secretary of War, and by him to be applied in carrying on the work, by contract or otherwise, as may be most economical and advantageous to the Government.

Amount expended during the fiscal year ending June 30, 1891, including outstanding liabilities, $26,166.29.

July 1, 1890, balance unexpended		$4,825.13
Amount appropriated by act approved August 30, 1890		75,000.00
Amount appropriated by act approved March 3, 1891		75,000.00
		154,825.13
June 30, 1891, amount expended during fiscal year		21,844.40
July 1, 1891, balance unexpended		132,980.73
July 1, 1891, outstanding liabilities	$9,148.02	
July 1, 1891, amount covered by uncompleted contracts	47,917.17	
		57,065.19
July 1, 1891, balance available		75,915.54
Amount (estimated) required for completion of existing project		197,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		150,000.00

(See Appendix G G G.)

MILITARY AND OTHER MAPS.

The following maps have been photolithographed and an edition printed:

Map of bulkhead lines for the Hudson River, New York, from Troy to New Baltimore, in five sheets.

Map of pierhead and bulkhead lines for the west shore of the Hudson River, from Guttenberg to Bloomer, N. J.

Map of pierhead and bulkhead lines for part of the Raritan Bay and Raritan River, New Jersey.

Map of pierhead and bulkhead lines of Raritan River, New Jersey, from Crab Island to head of navigation, New Brunswick.

Sketch of west half of the south shore of Staten Island, New York, showing the pierhead line east side of Sequines westward to Wards Point.

Map of pierhead and bulkhead lines for Ellis Island, New Jersey.

Map of pierhead and bulkhead lines north shore of the East River, from Point Morris to Throg Neck, New York; for the south shore of the East River, from Lawrence Point to Willets Point, Long Island, and around River, North and South Brother islands.

Map of pierhead and bulkhead lines for Newtown Creek, New York.

Boston Harbor, Massachusetts. Map of Mystic River and Chelsea Creek. Boston Harbor Line Board, sheet J.

Botton Harbor, Massachusetts. Map of Mystic and Malden Rivers. Boston Harbor Line Board, Sheet L.

Boston Harbor, Massachusetts. Map of north shore of Jeffrie Creek to Winthrop Point. Boston Harbor Line Board, sheet M.

Harbor lines for harbors of Norfolk and Portsmouth, Va.

Harbor lines in Elizabeth River and the western branch.

Harbor lines in eastern branch of the Elizabeth River, Virginia, from Norfolk and Western Railroad Bridge to Broad Creek.

Harbor lines in southern branch of the Elizabeth River, Virginia, from United States Navy Yard to Money Point.

The following maps have been prepared in this office, and an edition printed:

Map of the United States showing the military divisions, departments, and posts, 1891.

Outline map of the United States and Territories showing the tonnage of the navigable rivers of the United States.

RECONNAISSANCES AND EXPLORATIONS.

The following officers have been on duty at the headquarters of the military divisions and departments engaged in preparing such maps and making such surveys as were required by their respective commanding officers.

Capt. William L. Marshall, Corps of Engineers, at headquarters, Division of the Missouri.

Maj. Garrett J. Lydecker, Corps of Engineers, at headquarters, Department of the Columbia, until May 13, 1891, since which date Capt. Charles H. Clark, Ordnance Department.

Lieut. Charles A. Worden, Seventh U. S. Infantry, at headquarters, Department of the Platte.

Lieut. James E. Runcie, First U. S. Artillery, at headquarters, Division of the Pacific.

Capt. William L. Marshall, engineer officer, Division of the Missouri,

reports that there has been no field work in progress during the year. The office work has consisted in collecting, compiling, and plotting geographical information for the improvement of existing maps; in making reductions and enlargements and facsimile copies and tracings of maps of military and Indian reservations, posts, scouts, reconnaissances, etc., for use at the headquarters and elsewhere in the division, for file and forwarding. During the year the engineer officers of the departments included in the division have forwarded such special reports and maps of work done as were useful to the major general commanding the division, as well as to the other officers connected with the headquarters.

(See Appendix H H H 1.)

Capt. Charles H. Clark, Ordnance Department, in charge of engineer office, Department of the Columbia, reports that the operations have included a resurvey of the boundaries of the Boisé Barracks Military Reservation and minor surveys within the reservation of Vancouver Barracks. Maps, tracings, and solar prints have been prepared and issued as required for official purposes, and additions have been made to the department map as new information became available.

(See Appendix H H H 2.)

Lieut. Charles A. Worden, Seventh United States Infantry, acting engineer officer, Department of the Platte, reports that the work performed in his office during the year has been principally map compilation, a map of the Pine Ridge and Rosebud Indian Reservations and surrounding country having been projected on a scale of 1:1000000, and embracing the territory surrounding the Pine Ridge Indian Agency for a radius of nearly 200 miles, and another map has been compiled of the country surrounding the Pine Ridge and Rosebud Indian Agencies, on a scale of 8 miles to an inch, showing more details than the former map. In the fall of 1890 a map was commenced of that portion of the department east of the 103d meridian, which will embrace the States of Iowa, Nebraska, South Dakota, Kansas, and portions of Missouri, Minnesota, Wisconsin, and Illinois. This map is projected so as to join the map of the western portion of the department already published, thus making one map of the entire department with adjacent territory, and it is expected that it will be completed before the close of the next fiscal year. Numerous maps, tracings, blue-prints, engineering instruments, note-books, etc., have also been issued from the office.

(See Appendix H H H 3.)

Lieut. James E. Runcie, First United States Artillery, acting engineer officer, Division of the Pacific, reports that, owing to the fact that the assistant in his office has been assigned to duty as assistant to the division inspector of artillery, very little has been accomplished in the way of office work, which has consisted of making original drawings, tracings, and blue-prints, and in map-mounting.

(See Appendix H H H 4.)

ESTIMATES FOR AMOUNTS REQUIRED FOR SURVEYS AND RECONNAISSANCES IN MILITARY DEPARTMENTS, AND FOR MAPS, INCLUSIVE OF WAR MAPS.

For military surveys and reconnaissances and surveys of military reservations by the engineer officers attached to the several headquarters of military departments, being an average of $2,142.86 for each of

seven military departments west of the Mississippi River, $15,000; for publication of maps for use of the War Department, inclusive of war maps, $10,000; total, $25,000.

Attention is specially invited to this estimate for appropriation and to the important uses for which it is intended.

At the headquarters of the military departments west of the Mississippi River there are stationed officers of the Corps of Engineers, or other officers detailed to act, whose duty it is to make reconnaissances for military purposes, to make such surveys and prepare such maps as may be required by their respective commanding officers. In recent years no appropriations have been made for these purposes, and, consequently, these officers have been very much cramped from lack of the necessary means, and the usefulness of their offices has been very much reduced in consequence. The maps of these departments are constantly in need of revisions and additions, which the officers make so far as possible, but with no means even for the purchase of paper their efforts are limited in results.

Paragraph 383 of the Army Regulations requires that the commanding officer of each post where there are fixed batteries bearing upon a channel will call upon the Engineer Department for accurate charts showing the soundings to the extent of the ranges of the guns. Calls upon this department to perform its duty under this regulation can not be honored from lack of means.

Maps of certain military departments are now being prepared and should be published.

Of the 1,100 copies of each map printed under the act alluded to, all those not printed in this office (47 sheets) have been exhausted for some time, and the calls for them can only be honored with sets deficient in that number of sheets.

Besides all this, there is much information in this office relative to military geography which could with little expense be made available for the information of officers of the Army; for instance, there are on the office files detailed maps of regions of Europe which may become at an early day the theaters of war, and it would be of great advantage to the service if such information as these maps give could be made available for the study of officers, especially on the outbreak of hostilities. Were the means provided, this office would be glad to compile and to disseminate the information on its files.

It is the policy of this country to keep a standing army small in numbers, but it is its expectation that it should be a highly instructed one, and a small outlay as here referred to will be conducive to that end.

Applications from officers of the Army have been received for maps of certain regions of Europe, and it was with great regret that this office could not render this assistance to officers desirous of improving themselves professionally, especially when the material was on its files.

OFFICE OF THE CHIEF OF ENGINEERS.

During the fiscal year ending June 30, 1891, the following-named officers were in charge of the several divisions of the office of the Chief of Engineers:

FIRST DIVISION.—*Fortifications and Surveys relating thereto—Armament of Fortifications—Sites for Engineer Defenses—Boards of Engineers for Defenses—Military Reservations—Land Files—Public Buildings and Grounds—Washington Aqueduct—Roads and Bridges in Yellowstone National Park.*

SECOND DIVISION.—*Battalion of Engineers—United States Engineer School and Engineer Depot and Post—Professional Papers and Information—Personnel—Orders.*

Capt. John G. D. Knight.

THIRD DIVISION.—*Improvement of Rivers and Harbors and Surveys relating thereto—Bridging Navigable Waters of the United States—The removal of Wrecks Obstructing Navigation.*

Maj. Henry M. Adams.

FOURTH DIVISION.—*Accounts for Disbursements—Contracts—Returns of Engineer Property and Instruments—Application for Remittances—Appropriations and Estimates—Blank Forms.*

FIFTH DIVISION.—*Survey of the Lakes—Explorations and Surveys—Reconnaissances—Maps—Instruments—Claims.*

Capt. Thomas Turtle.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

STATEMENT SHOWING THE RANK AND THE DUTIES OF OFFICERS OF THE CORPS OF ENGINEERS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

RANK AND NAME.	DUTIES.
BRIGADIER-GENERAL AND CHIEF OF ENGINEERS.	
Thos. Lincoln Casey...	In command of the Corps of Engineers and in charge of the Engineer Department. Charged with the supervision of such matters connected with construction of jetties and other works at South Pass, Mississippi River, as require the action of the Secretary of War. In charge of the construction of the building for Library of Congress under act of October 2, 1888. Member of Rock Creek Park Commission by virtue of act of Congress approved September 27, 1890. Member of the Light-House Board.
COLONELS.	
George H. Mendell....	Division Engineer of the Pacific Division. Member of the Board of Engineers when it is acting upon matters pertaining to the defensive works of the Pacific Coast. In charge of the defensive works at Alcatraz Island, at Lime Point, Fort Winfield Scott, and Battery at Fort Mason, in San Francisco Bay; and of the Battery at San Diego, Cal. In charge of construction of gun and mortar batteries for defense of San Francisco, and of a torpedo shed at Yerba Buena Island, San Francisco Harbor, Cal. In charge of the improvement of Oakland Harbor, Napa River, and Redwood Creek, Cal. In charge of survey of San Francisco Harbor, San Pablo and Suisun bays, Strait of Carquinez, and mouths of San Joaquin and Sacramento rivers, Cal. In charge of examination of San Rafael River, Cal. Member of Boards of Engineer Officers to consider and report on the subject of the harbor lines at San Francisco and San Diego harbors and adjacent waters, and at San Pedro, Cal.; at Portland and at Astoria Harbor, Oregon, and for Humboldt Bay, Cal.; on deep-water harbor on the Pacific Coast between Points Duma and Capistrano; on harbor of refuge at Port Orford, Oregon; on ship canal to connect Lakes Union, Wash., and Samamish with Puget Sound; and on improvement of Humboldt Harbor, and of Sacramento and Feather rivers, Cal. Member of Boards of Officers for the examination for promotion of certain officers of the Corps of Engineers; and to report on a site for a military post and harbor defenses at or near San Diego, Cal. Member of Commission to select a suitable site for a dry dock on the Pacific Coast.
Henry L. Abbot..... *Bvt. Brig. General.*	Division Engineer of the Northeast Division. Member and president of The Board of Engineers. In charge of certain experiments with torpedoes. Member of Board of Ordnance and Fortification. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Boston, and of New York Harbor and its adjacent waters. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
COLONELS. (continued.)	
William P. Craighill ..	Division Engineer of the Southeast Division. In charge of the defensive works at Forts Carroll and McHenry, Baltimore, Md. In charge of the improvement of the harbor at Baltimore, Md. In charge of the improvement of James River, Va., and New River, Va. and W. Va., Gauley, Great Kanawha, and Elk rivers, W. Va. In charge of examination of Patapsco River, Md., and Elk River, Va. To supervise the construction of bridge across the Great Kanawha River at Charleston, W. Va. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of New York Harbor and its adjacent waters; of the port of Philadelphia; of Norfolk and Portsmouth harbors and their adjacent water; in James River from Richmond to City Point, Va.; to examine and report upon plans for a bridge proposed to be built across Great Kanawha River at Charleston, W. Va.; to consider and report upon a project for improving the harbor of Philadelphia, Pa.; the lock, dam, and abutment at Lock and Dam No. 1, Cumberland River; the dam to be built in the Big Sandy River near Louisa, Ky.; and a project for a lock at the mouth of Bayou Plaquemine, La. Member of Commission of Engineer Officers on national harbor of refuge near the mouth of Delaware Bay. Member of Board of Officers on production of steel forgings and erection of factories for high-power guns. Member of the Light-House Board.
Cyrus B. Comstock.... *Bvt. Brig. General.*	Division Engineer of the Southwest Division. Member of The Board of Engineers. Member of Board of Visitors for U. S. Engineer School. Member and president of the Mississippi River Commission, created by act of Congress approved June 28, 1879. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of New York Harbor and its adjacent waters, and of the port of Philadelphia; upon a project for improving the harbor of Philadelphia, Pa.; and on improving the harbor at Sabine Pass, Tex. Member of Commission of Engineer Officers to consider and report upon the value of a channel constructed by the Buffalo Bayou Ship Channel Company. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers.
Orlando M. Poe..... *Bvt. Brig. General.*	Division Engineer of the Northwest Division. In charge of the defensive works at Fort Wayne, Mich. In charge of the improvement of the harbors at Cheboygan, Au Sable, and at Thunder Bay; harbor of refuge at Sand Beach; of the St. Marys River, at the Falls; of the St. Clair Flats Ship Canal; and of the rivers Detroit, Saginaw, Clinton, and Rouge, Thunder Bay River, Alpena, Black River at Port Huron, and mouth of Black River, Mich., and Hay Lake Channel of the St. Marys River; construction of dry dock, St. Marys Falls Canal, and of dredging at Grosse Pointe Channel. In charge of St. Clair Flats Ship Canal and St. Marys Falls Canal, Mich. In charge of issuing charts of Northern and Northwestern Lakes, and of water-level observations on Lake Huron. In charge of examination of Sebewaing River, Corsica Shoal, the American Channel of Detroit River, Rouge River, Mich., and for ship channel connecting waters of the lakes between Chicago, Duluth, and Buffalo. In charge of removal of wreck of coal vessel *M. E. Tremble* in the rapids of St. Clair River at Fort Gra-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
COLONELS. (continued.)	
Orlando M. Poe ..... *Bvt. Brig. General.*	tiot, Mich. Member of Boards of Engineer Officers to consider and report upon the subject of harbor lines in Portage Lake, Mich., at Duluth, Minn.; the Bay of St. Louis, Superior Bay, and adjacent waters; at Chicago, Ill., and at Cleveland, Ohio; and on proposed dam at Lock No. 1, and plans for Lock No. 2, Cumberland River. Member of Board of Officers to select the necessary sites for the buildings to be erected at the new post of Fort Brady, Mich.
David C. Houston	Member of The Board of Engineers. In charge of the defensive works at Forts Griswold, Trumbull, and Hale, Conn., Columbus, Wood, Wadsworth, and Tompkins and its batteries, N. Y.; Castle Williams, South Battery, new Barbette Battery at Governors Island, N. Y.; of sea wall at same; of sea wall and embankment at Davids Island, N. Y.; and of permanent platforms for modern cannon of large caliber. In charge of construction of gun batteries on Staten Island for defense of New York. In charge of the improvement of the harbors of New London, Clinton, New Haven, Milford, Bridgeport, Black Rock, Stamford, Norwalk, Five-Mile River, and Wilsons Point, Conn., and Greenport, Port Chester, New Rochelle, Glen Cove, Echo Harbor, Flushing Bay, Port Jefferson Inlet, Larchmont, and Huntington, N. Y.; of the construction of breakwaters at New Haven, and harbor of refuge, Duck Island Harbor, Conn. In charge of the improvement of the Housatonic River and for breakwater, Thames and Mystic rivers, Conn., Connecticut, Mass. and Conn., East Chester Creek, Patchogue River, and Browns Creek, N. Y. In charge of examination of Connecticut River from Long Island Sound to Hartford; Shaws Cove, New London; Connecticut River below Hartford; Saugatuck River, Stamford Harbor; Cos Cob or Miamus River, and Stony Creek River, Conn.; Sag Harbor, Peconic River, and Mattituck Bay, N. Y. In charge of survey of Sag Harbor and Peconic River, N. Y., Stamford Harbor, and Cos Cob or Miamus River, Conn. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of New York Harbor and its adjacent waters; of Stamford Harbor, and at Bridgeport, Conn. Member of Commission on improvement of the harbor of Wilmington, Del. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers. Member of Board of Visitors for U. S. Engineer School.
LIEUTENANT-COLONELS.	
George H. Elliot.....	In charge of the Washington Aqueduct; increasing water supply of the city of Washington; and of the disbursement of the funds pertaining to the erection of fishways at Great Falls of the Potomac.
Henry M. Robert	Detached; Engineer Commissioner of the District of Columbia.
William E. Merrill..... *Bvt. Colonel.*	In charge of the improvement of the Ohio River; Monongahela and Cheat rivers, W. Va.; Allegheny River, Pa., and of the Muskingum River, Ohio. In charge of the construction of harbor of refuge at mouth of Muskingum River, of a dam at Herrs Island, and of a movable dam at or below the mouth of Beaver River, Pa. In charge of operating snag boats on the Ohio River. In charge of examination of Tionesta Creek, Pa., the Ohio River, between

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
William E. Merrill..... *Bvt. Colonel.*	the mouth of Green River, Ky., and Evansville, Ind., and harbor of Owensboro, Ky. To exercise supervision over the construction of bridges across Ohio River, between Cincinnati and Newport; near Ceredo, W. Va.; at Wheeling, W. Va.; between Wheeling, W. Va., and Martins Ferry, Ohio; near the mouth of Corks Run, in Allegheny County, Pa., over Muskingum River, at Stockport; at Zanesville, and above the mouth of Brush Creek, Ohio; over the Allegheny River at Pittsburg; and over Youghiogheny River at McKeesport, Pa. To supervise the laying of a pipe by the American Encaustic Tiling Company through the land of the United States along the bank of the canal from Second to Hughes street, Zanesville, Ohio. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines at Pittsburg, Pa., and on the Ohio to Davis Island Dam; on both sides of the Ohio River from the upper end of Martins Ferry to the lower end of the city of Bellaire, Ohio; and at Cincinnati, including the Licking River between its mouth and the bridge of the Louisville and Nashville Railroad; and on bridge across West Channel of Ohio River at Bridgeport, Ohio; on proposed dam at Lock No. 1, and plans for Lock No. 2, Cumberland River. Engineer fourteenth lighthouse district.
John M. Wilson..... *Bvt. Colonel, Ex-officio Colonel of Engineers.*	Detached; Superintendent of the Military Academy.
John W. Barlow.....	In charge of the improvement of the rivers Tennessee, Tenn., Ala., and Ky.; Cumberland above and below Nashville, Ky., and Tenn.; Hiawassee, Caney Fork, French Broad, and Clinch, Tenn.; and South Fork of the Cumberland, Ky. In charge of examination of harbor of Smithland, Ky.; Obion and Little Pigeon rivers, Tenn., and mouth of Gunters Creek, Ala. In charge of survey of Obion River, Tenn. To exercise supervision over the construction of bridges across the Tennessee River at or near Chattanooga: at Knoxville, and at Perryville, Tenn. Member of Board of Engineer Officers to examine and report what changes and additions are required in the Muscle Shoals Canal System; and to consider and report on proposed dam at Lock No. 1, and plans for Lock No. 2, Cumberland River.
Peter C. Hains	In charge of the defensive works at Forts Foote and Washington, Md.; Wool and Monroe, Va. In charge of the improvement of the Potomac River at Washington, the establishment of the harbor lines, and of the raising of the river flats; and of channel in the Eastern Branch, Potomac River. In charge of the improvement of the harbor at Breton Bay, Leonardtown, and at entrance of St. Jeromes Creek, Md. In charge of the improvement of Patuxent River, Md.; of the rivers Rappahannock, Chickahominy, Mattaponi, Totusky, York, Pamunky, and Staunton, Va., and Dan, Va. and N. C.; of channel in Potomac River through flats in front of landing at Mount Vernon, and of Nomini, Urbana, Occoquan, and Aquia creeks, Va. In charge of examination and of survey of Eastern Branch of Potomac River, Md. and D. C., and of Potomac River, Va. and Md.; examination and survey of a breakwater for harbor of refuge in Lynn Haven Bay, Va., and examination of St. Jeromes Bay, Piscataway, St. Leonards,

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
Peter C. Hains	Newport, and Smiths creeks, Md.; Potomac Creek, Chickahominy and Wicomico rivers, Upper Machodoc, Cranes, Nandua, and Piscataway creeks, Va. In charge of the construction of bridge across the Eastern Branch of Potomac River, D. C.; of bridge across Mill Creek; of a new wharf and of the sewerage system at Fort Monroe, Va. To report upon Senate resolution of July 18, 1890, as to the practicability and probable cost of constructing an avenue from the Washington Monument, along the Potomac River and Rock Creek, to the Columbian Park and Soldiers' Home, D. C. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of Norfolk and Portsmouth harbors and their adjacent waters; and in James River from Richmond to City Point, Va. Member of Board of Officers for the selection of site for a hospital building at Washington Barracks, D. C., and for preparing the plans and estimates necessary for converting the present post hospital into barracks for a light battery and the brick magazines near it into stables and gun sheds.
George L. Gillespie....	Member of The Board of Engineers. In charge of the defensive works at Forts Hamilton and Lafayette, N. Y., and fort at Sandy Hook, N. J. In charge of construction of gun and mortar batteries for defense of New York. In charge of the improvement of the harbors of New York, Rondout, and Saugerties, N. Y., and Raritan Bay, N. J. In charge of the improvement of the Hudson and Harlem rivers, N. Y.; channel in Gowanus Bay, Bay Ridge Channel in Gowanus Bay, and Buttermilk Channel; deepening Gedneys Channel and Newtown Creek and Bay, and Wappingers Creek, N. Y. In charge of the removal of obstructions in East River and Hell Gate, N. Y. In charge of resurvey of public land at Sandy Hook, N. J.; of survey of Bushwick Creek, Hudson River at Cornwall, western part of route from Main Channel from Jamaica Bay easterly to Long Beach Inlet for canal, Bronx River, and Westchester Creek, N. Y.; and of examination of Buttermilk and Gowanus Bay and Bay Ridge channels, Hudson River at Cornwall, Main Channel from Jamaica Bay easterly to Long Beach Inlet, for canal, Champlins Creek, Bronx River, and Westchester Creek, N. Y. In charge of removal of wrecks of schooners *Salamander* in Raritan Bay and *Francis E. Hallock* in New York Harbor. To exercise supervision over construction of proposed bridge across the East River between the city of New York and Long Island, and the work of making an opening in the United States dike on the right bank of the Hudson River. Member of Board of Visitors for U. S. Engineer School. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Boston; of New York Harbor and its adjacent waters; of Stamford Harbor, and at Bridgeport, Conn.; on obstructions to navigation in the Hudson River, and on deep-water harbor on the Pacific coast between Points Duma and Capistrano, and for the examination of Second Lieutenant Potter, Corps of Engineers, with view to his promotion.
Charles R. Suter.....	Member of the Mississippi River Commission created by act of Congress approved June 28, 1879. Member and president of the Missouri River Commission created by act of

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
Charles R. Suter.....	Congress approved July 5, 1884. In charge of examination of Missouri River from Little Point to a point opposite Leavenworth, and at Weston. To exercise supervision over the construction of two bridges across the Missouri River at or near Sioux City, Iowa, and of bridges opposite to or within the corporate limits of Nebraska City, Nebr.; at or near Nebraska City, Nebr.; at Omaha, Nebr.; between Omaha, Nebr., and Council Bluffs, Iowa; near Council Bluffs, Iowa, and East Omaha, Nebr.; between Kansas City and Sibley, Mo.; between Leavenworth, Kans., and Platte County, Mo.; between Wyandotte County, Kans., and Clay County, Mo.; between Clay and Jackson counties, and between St. Charles and the mouth of Missouri River, Mo., and near Quindaro, Kans. Member of Board of Engineer Officers to consider and report upon the plans and location of the proposed bridge across the Mississippi River at Clinton, Iowa. Engineer fifteenth and sixteenth light-house districts.
Jared A. Smith	In charge of the defensive works at Forts Knox, Popham, Gorges, Scammel, Preble, and McClary, Batteries at Portland Head and Gerrish Island, Me., and at Fort Constitution and Jerrys Point, N. H. In charge of the improvement of the harbors at Bangor, Belfast, Camden, Rockport, Rockland, Portland, and York, and Back Cove, Portland Harbor, Me., Portsmouth, N. H., harbor of refuge at Little Harbor, N. H., and the construction of breakwater from Mount Desert to Porcupine Island, Me. In charge of the improvement of the rivers Penobscot, Kennebunk, Saco, Narraguagus, Bagaduce, and Kennebec, Harrisseckit, St. Croix, and Pleasant, Me., Cocheco and Bellamy, N. H., Saco River Breakwater, Lubec Channel, and Mooseabec Bar, Me. In charge of examination of Kennebec River, from Waterville to steamboat wharf at Augusta, Sullivan Falls, Lubec Channel, harbor of Bluehill, Penobscot River, and Pepperell Cove, Me. In charge of survey of Kennebec River from Waterville to the steamboat wharf at Augusta, and Penobscot River, and survey and location of harbor lines at Bath, Me. In charge of removal of wrecks of schooners *Annie J. Russell* in Portland Harbor, and *Golden Eagle* and *Ceruleus* in Pleasant River, Me.
Samuel M. Mansfield...	In charge of the defensive works at Forts Warren, Winthrop, Standish, Andrew, Independence, and on Long Island Head, Mass. In charge of construction of gun and mortar batteries for defense of Boston Harbor. In charge of the improvement of the harbors at Newburyport, Lynn, Boston (including sea walls on Point Allerton, Great Brewster Island, Lovell Island, Gallop Island, Long Island Head, Rainsford Island, and Deer Island; Mystic and Charles rivers; Fort Point Channel, channel leading to Nantasket Beach, and Main Ship Channel), Provincetown, Plymouth, Scituate, Hingham, Gloucester, Winthrop, Wellfleet, and Manchester, Salem, including South River, and Stage Harbor at Chatham, Mass. In charge of construction of a national harbor of refuge (of the first class) at Sandy Bay, Cape Ann, Mass. In charge of the improvement of the Merrimac River at Mitchells Falls, Ipswich, Powow, and Weymouth rivers, Mass. In charge of examination of Kingston Harbor, Town River, shoals at mouth of North River, North, Mystic, Malden, Wey-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
LIEUTENANT-COLONELS. (continued.)	
Samuel M. Mansfield ..	mouth Back, and Essex rivers, Mass. In charge of survey of Kingston Harbor, Mystic, Weymouth Back, and Essex rivers, Mass. Member of Board of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Boston.
William R. King.....	Commanding Post and U. S. Engineer School at Willets Point, N. Y., and the Battalion of Engineers. In charge of the defensive works at Fort Schuyler and Willets Point; of the engineer depot at Willets Point; torpedoes for harbor defense, and experiments with the same. In charge of construction of gun and mortar batteries for defense of New York at eastern entrance of harbor. In charge of funds pertaining to the library of the U. S. Engineer School.
Wm. H. H. Benyaurd ..	In charge of the improvement of the harbors at Wilmington, San Diego, and Redwood; and construction of breakwater at San Luis Obispo Harbor, Cal. In charge of the improvement of Napa River and Redwood Creek, Cal. In charge of examination of Colorado River above Yuma, Ariz., to Eldorado Canyon, San Simeon Bay, Alviso Harbor and Creek, harbor of refuge at Santa Cruz, Redwood Creek, and Redondo Beach Harbor, Cal. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of San Francisco and San Diego harbors and adjacent waters; of Humboldt Bay, and at San Pedro, Cal.; on improvement of Humboldt Harbor, Cal.; on deep-water harbor on the Pacific coast between Points Duma and Capistrano; and on the mining-débris question in the State of California, etc. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers.
MAJORS.	
Garrett J. Lydecker ...	Detached; Engineer Officer, Department of the Columbia. Member of a general court-martial convened at Fort Sherman, Idaho, December 15, 1890. In charge of the Louisville and Portland Canal. In charge of the improvement of the Falls of the Ohio River, the Indiana Chute Fall, Ohio River, Wabash River, Indiana and Illinois, and White River, Indiana. To exercise supervision over the construction of bridge across the Ohio River at Louisville, Ky.
Amos Stickney	In charge of the improvement of the harbors at Erie, Pa., and Buffalo, Wilson, Olcott, Oak Orchard, and Dunkirk, N. Y. In charge of improvement of Tonawanda Harbor and Niagara River, N. Y. In charge of the preservation and protection of the peninsula of Presque Isle, Erie Harbor, Pa. In charge of examination and of survey of Port Day above Niagara Falls, N. Y. Member of Boards of Engineer Officers on obstructions to navigation in the Hudson River; and to consider and report upon the subject of harbor lines at Cleveland, Ohio.
Alexander Mackenzie..	In charge of the improvement of the Mississippi River from Minneapolis to Des Moines Rapids, and at Rock Island and Des Moines rapids. In charge of operating the dry dock at the Des Moines Rapids Canal; the Des Moines Rapids Canal and snag boats and dredge boats on Upper Mississippi River; and of harbors of refuge on Lake Pepin at Stockholm, Wis., and Lake City, Minn. In

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Alexander Mackenzie..	charge of examination of the Slough at Hamilton, Ill.; of examination and survey of Mississippi River at and above Clinton, Iowa. To supervise the construction of bridges across the Mississippi River at Muscatine, at Lyons, at or near Clinton, Iowa; at La Crosse, Wis.; at St. Paul; at Winona, Minn.; and from Winona, Minn., to the opposite shore in Wisconsin. Member of Boards of Engineer Officers to establish the harbor lines in Quincy Bay, Ill.; to examine and report what changes and additions are required in the Muscle Shoals Canal System; on improvement of Sacramento and Feather rivers, Cal.; on improving the Mississippi River from the mouth of the Illinois River to the mouth of the Ohio River; to consider and report upon a project for closing Hickory Chute, Mississippi River; upon the reopening of Willow Slough, Mississippi River; on proposed bridge across the Mississippi River at Clinton, Iowa; upon the subject of a lock, dam, and abutment at Lock and Dam No. 1, Cumberland River, and upon a project for a lock at the mouth of Bayou Plaquemine, La. Member of the Missouri River Commission created by act of Congress approved July 5, 1884.
Oswald H. Ernst	In charge of public buildings and grounds in the District of Columbia, with the rank of colonel. In charge of the improvements over the grave of Thomas Jefferson at Monticello, Va., and of the erection of a monument to mark the birthplace of George Washington. In charge of the care and maintenance of the Washington Monument. Member of the Mississippi River Commission created by act of Congress approved June 28, 1879. Member of the Missouri River Commission created by act of Congress approved July 5, 1884. Member of Boards of Engineer Officers on improving the entrance to Galveston Harbor, Tex., and the Mississippi River from the mouth of the Illinois River to the mouth of the Ohio River.
David P. Heap	Detached; Engineer third light-house district.
William Ludlow ..... *Bvt. Lieut. Colonel.*	In charge of the improvement of the harbors at Frankfort, Manistee, Pentwater, White River, Muskegon, Grand Haven, Black Lake, Saugatuck, South Haven, St. Joseph, and Charlevoix, and entrance to Pine Lake, and harbors of refuge at Ludington and Portage Lake, breakwater and harbor of refuge, Petoskey Harbor, Mich., and harbor at Michigan City, Ind., and of St. Joseph River, Mich. In charge of examination and of survey of Grand River below Grand Rapids, Mich. To supervise the construction of bridge across Trail Creek, at Michigan City, Ind. Member of Board of Engineer Officers to investigate and report upon the alleged obstruction of navigation by a bridge over the Chicago River at Chicago, Ill. Engineer ninth and eleventh light-house districts.
William A. Jones.....	In charge of the improvement of the Chippewa River and protection of Yellow Banks on the same; of the Minnesota and St. Croix rivers, and the Red River of the North; and of the Mississippi River above the Falls of St. Anthony. In charge of the improvement of the Yellowstone River, Mont. and N. Dak. In charge of construction and improvement of roads and bridges in Yellowstone National Park. In charge of the construction of reservoirs at headwaters of the Mississippi River and its tributaries. In

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
William A. Jones.....	charge of gauging the waters of the Mississippi River and its tributaries at or near St. Paul, Minn. In charge of the examinations and surveys of the sources of the Mississippi, St, Croix, Chippewa, and Wisconsin rivers, with the view to ascertaining the practicability and cost of creating and maintaining reservoirs, etc. In charge of examination of Red River, Minn., and tributaries above Fergus Falls and Crookston, and Big Stone Lake, Red River of the North, N. Dak. and Minn., Creel Bay, Totten Bay, and Minnewauken shoals, in Devils Lake, N. Dak., and harbor at Hudson, Wis. In charge of survey of Red River, Minn., and tributaries above Fergus Falls and Crookston, and Big Stone Lake. To exercise supervision over construction of bridges across Red River of the North at Alpha, De Mers, and Minnesota avenues, Grand Forks, N. Dak.
Andrew N. Damrell....	In charge of the defensive works at Forts Morgan and Gaines, Ala., and fort on Ship Island, Miss. In charge of the improvement of the harbors at Mobile, Ala., and Biloxi, Miss. In charge of the improvement of the rivers Warrior and Tombigbee, and Black Warrior, Ala., Pascagoula, Pearl, and Noxubee, Miss., Tombigbee, Ala. and Miss., the roadstead leading into Back Bay of Biloxi, in Mississippi Sound, Miss., Bluff Creek, Chickasahay and Leaf rivers, Miss., and Bogue Chitto, La. In charge of examination of Sucarnochee River, Ala.
Charles J. Allen	In charge of the improvement of the entrance to Galveston Harbor and of the harbor at Brazos Santiago, Tex. In charge of the improvement of ship channel in Galveston Bay, Aransas Pass and Bay up to Rockport and Corpus Christi, Buffalo Bayou, Trinity River, and mouth of Cedar Bayou, Tex. In charge of examination for survey to remove obstructions at mouth of Double Bayou, in Chambers County; of St. Charles, Aransas, to remove Half-Moon Reef, and West Galveston Bays, and Brazos, Colorado, and Trinity rivers, Tex. In charge of survey of West Galveston Bay, Tex. Member of Board of Engineer Officers on improving the entrance to Galveston Harbor, Tex. Member of Commission of Engineer Officers to consider and report upon the value of a channel constructed by the Buffalo Bayou Ship Channel Company.
Charles W. Raymond ..	In charge of the defensive works at Fort Mifflin, Pa.; Fort Delaware and fort opposite Fort Delaware, Del.; at Finns Point and site for defenses at Red Bank, N. J. In charge of the improvement of the harbors at Philadelphia and Delaware Breakwater; ice harbors at Marcus Hook, Pa., and the head of Delaware Bay; of the Schuylkill River, Pa.; Delaware River, from Trenton to its mouth, including Rancocas River; Maurice River, Alloway and Mantua creeks, N. J., and of the construction of pier near Lewes, Del. In charge of examination of Little Egg Harbor Bay and Inlet, including Great Bay, sound between Barnegat Bay and Great Egg Harbor Bay, for breakwater at Cape May City, Toms and Shark rivers, Pensauken and Goshen creeks, and thoroughfare from Cape May to the Great Bay north of Atlantic City, N. J., and West Branch of Susquehanna River, Pa. In charge of survey of Toms River and Goshen Creek, N. J. In charge of removal of wreck of steamer *Mediator* at Barnegat, N. J., and of wreck of canal schooner *Gen. W. T. Sherman*

Statement showing rank and duties of officers of Corps of Engineers---Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Charles W. Raymond ..	from upper part of Delaware Bay. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of the port of Philadelphia; upon a project for improving the harbor of Philadelphia, Pa., and on obstructions to navigation in the Hudson River. Member of Commission of Engineer Officers on national harbor of refuge near the mouth of Delaware Bay. Member of commission on improvement of the harbor of Wilmington, Del.
L. Cooper Overman	In charge of the improvement of harbors at Monroe, Mich.; Toledo, Port Clinton, Sandusky, Vermillion, Huron, Cleveland, Fairport, Ashtabula, and mouth of Black River, and of Sandusky River, Ohio. In charge of water-level observations on Lake Erie. In charge of examination and of survey of Conneaut Harbor, and Grand River between Richmond and the mouth, Ohio. Member of Board of Engineer Officers to consider and report upon the subject of harbor lines at Cleveland, Ohio. Engineer tenth light-house district.
Alexander M. Miller ...	In charge of the improvement of the Mississippi River, removal of snags, etc.; Mississippi River between the mouths of the Illinois and Ohio rivers; and harbor at St. Louis, Mo., Osage River, Mo. and Kans., Gasconade River, Mo., and Kaskaskia River, Ill. To exercise supervision over the construction of bridge across the Mississippi River at St. Louis, Mo. Member of Boards of Engineer Officers to establish the harbor lines in Quincy Bay, Ill.; to consider and report upon the plan and location for a bridge across Red River, near Alexandria, La.; upon a project for closing Hickory Chute, Mississippi River; and upon the reopening of Willow Slough, Mississippi River, and on improving the Mississippi River from the mouth of the Illinois River to the mouth of the Ohio River.
Milton B. Adams	In charge of the defensive works at Fort Montgomery, N. Y.; in charge of the improvement of the harbors at Ogdensburg and Plattsburg, N. Y., and Burlington, Vt.; of the channel between the islands of North Hero and South Hero, and construction of breakwaters at Rouses Point, N. Y., and Gordon Landing, Lake Champlain, Vt.; in charge of the improvement of St. Lawrence, Ticonderoga, Grass, and Great Chazy rivers; of narrows at Lake Champlain, N. Y., and of Otter Creek, Vt.; in charge of examination of Inner Bay near mouth of Saranac River at Plattsburg, and Boquet River, N. Y.; to supervise the construction of bridge across Lake Champlain at Grand Isle, Vt.; in temporary charge of the defensive works at Forts Porter, Niagara, and Ontario, N. Y.; of the improvement of the harbors at Charlotte, Great Sodus Bay, Little Sodus Bay, Oswego, Sacketts Harbor, and Pultneyville, N. Y.; and of water-level observations on Lake Ontario.
Wm. R. Livermore.....	In charge of the defensive works of Forts at Clark Point, Mass., Dutch Island and Fort Adams, R. I.; in charge of the improvement of the harbors of Nantucket, Woods Holl, Wareham, Hyannis, New Bedford, Vineyard Haven, Marthas Vineyard inner harbor at Edgartown, and Westport and East and West Branch of Westport River, Mass., Newport, Block Island, and Greenwich Bay, R. I., and Stonington, Conn., cove near Coasters Harbor Island, and water way between said island and Rhode Island, and con-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Wm. R. Livermore	struction of harbor of refuge at or near Point Judith; in charge of the improvement of the rivers Taunton, Mass., Pawtucket, Providence, Warren, and Pawcatuck, and Narragansett Bay, R. I., and removal of Green Jacket Shoal, Providence River, R. I.; in charge of examination of Canapitsit Channel between Cuttyhunk and Neshawana islands, and Menemsha Bite, Mass., Watch Hill Cove in Little Narragansett Bay, Narragansett Bay Channel, and Newport Harbor, R. I.; in charge of survey of Canapitsit Channel between Cuttyhunk and Neshawana islands, and Menemsha Bite, Mass.; in charge of removal of wrecks of schooners *Benjamin Gartside*, *Josiah Whitehouse*, and *Weybosset* in Vineyard Sound, and *S. S. Bickmore* in Hyannis Harbor, Mass.; in charge of construction of draw protection at the bridge across Taunton River, Somerset, Mass.; to supervise the construction of bridge at Osterville, Mass.; member of Board of Engineer Officers to consider and report upon the subject of the harbor lines of the Port of Boston.
William H. Heuer.....	In charge of the improvement of Humboldt Harbor and Bay, Cal. In charge of the improvement of the Sacramento, Feather, San Joaquin, and Mokelumne Rivers, and Petaluma Creek, Cal. In charge of examination of survey of Mokelumne River, Cal. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines of San Francisco and San Diego harbors and adjacent waters; of Humboldt Bay, and at San Pedro, Cal.; on improvement of Humboldt Harbor, Cal., and to examine and investigate the mining-débris question in the State of California, etc. Member of Board of Officers for the examination for promotion of certain officers of the Corps of Engineers. Engineer twelfth light-house district.
William S. Stanton....	Detached; Engineer first and second light-house districts.
Thomas H. Handbury..	In charge of the defensive works at Fort Stevens, Oreg., and Canby, Wash. In charge of the improvement of the Canal at the Cascades, Oregon, mouth of the Columbia River, the Lower Columbia River, Oregon, and Wash., Willamette River above Portland, and Lower Willamette River below Portland, and Youngs and Klaskuine rivers, Oregon, and of the Cowlitz River, Wash. In charge of examination of Lower Willamette and Columbia, Willamette, Lower Columbia, and Lewis and Clarks rivers, Yamhill River from mouth to McMinnville, and Youngs Bay Channel, Oregon, Grays River, and Columbia River from mouth of Willamette to Vancouver, Deep, Skamakawa and Crooked rivers, and Grays River, for snagging, Wash. In charge of survey of Willamette River at Clackamas Rapids, Ross Island, and Corvallis, Lower Willamette and Columbia rivers, Yamhill River from mouth to McMinnville, and Lewis and Clarks River, Oregon, Columbia River from mouth of Willamette to Vancouver, and Grays River, for snagging, Wash. In charge of water gauges on the Columbia River from Astoria to the bar. In charge of removal of wreck of the *Sylvia de Grasse* from the channel of the Columbia River opposite Upper Astoria, Oregon. To supervise the construction of bridge across the Columbia River near Vancouver, Wash. Member of Boards of Engineer Officers to examine and investigate the mining-débris question in the State of California, etc.; to con-

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
Thomas H. Handbury..	sider and report on the subject of the harbor lines at Portland, and at Astoria Harbor; and on harbor of refuge at Port Orford, Oregon; to formulate and submit a project for improving the mouth of Siuslaw River, Oregon; and on ship canal to connect Lakes Union, Wash., and Samamish with Puget Sound. Engineer thirteenth light-house district.
James C. Post.....	Detached; military attaché to the United States legation at London. Witnessed a series of trials on the firing grounds near Buckau and Tangerhutte, September 22–27, 1890, by the firm of Grusonwerk, Magdeburg-Buckau, Germany.
James F. Gregory	Detached; Engineer secretary of the Light-House Board. On sick leave of absence.
Henry M. Adams	In charge of the third division, Office of the Chief of Engineers. Member of Boards of Engineer Officers to examine and report what changes and additions are required in the Muscle Shoals Canal system, and on improving the entrance to Galveston Harbor, Tex.
Chas. E. L. B. Davis ..	In charge of the improvement of the harbors at Manistique and Cedar River, Mich., Menomonee, Oconto, Pensaukee, Green Bay, Ahnapee, Kewaunee, Two Rivers, Manitowoc, Sheboygan, Port Washington, Milwaukee, Racine, and Kenosha, Wis., and Waukegan, Ill. In charge of harbors of refuge at Milwaukee Bay, Wis., and at entrance to Sturgeon Bay Canal, Lake Michigan, Mich. In charge of the improvement of Menomonee River, Mich. and Wis., south outlet of Lake Winnebago, and removing sand bar at outlet of Fond du Lac River, and of the rivers Fox and Wisconsin, Wis. In charge of water-level observations on Lake Michigan. Member of Board of Engineer Officers to investigate and report upon the alleged obstruction of navigation by a bridge over the Chicago River at Chicago, Ill.
James B. Quinn	In charge of the improvement of the harbors of Duluth, Grand Marais, Agate Bay, Minn., Superior Bay on Lake Superior, St. Louis Bay, and Ashland, Wis., Ontonagon, Eagle Harbor, and Marquette, Mich., harbor of refuge at Grand Marais, Mich., and of Minnesota Point at Superior, Wis. In charge of examination of St. Louis River, Minn. and Wis., Allonez Bay and Nemadji River, for a distance of 4 miles above its mouth, Wis. In charge of survey of St. Louis River, Minn.; resurvey of Marquette Harbor, and resurvey and relocation of harbor line in Portage Lake, Houghton County, Mich. In charge of water-level observations on Lake Superior. In charge of the establishment and maintenance of harbor lines in Portage Lake, Mich. To exercise supervision over construction of bridge across the St. Louis River between the States of Minnesota and Wisconsin. In charge of the defensive works at Forts Jackson, St. Philip, Livingston, Pike, Macomb, Tower Dupré, Battery Bienvenue, and Tower at Proctorsville, La. In charge of the improvement of the Amite River and Bayou Manchac, Tickfaw, Tchefuncte, and Bogue Falia rivers, mouth and passes of Calcasieu River, bayous Terre Bonne and Courtableau, and Bayou Teche from mouth to St. Martinsville, La.; harbor at Sabine Pass, Blue Buck Bar, and Neches River, Tex., and Sabine River, La. and Tex., Bayou Plaquemine, for securing a navigable channel up to Plaquemine Dike, and of Bayou La Fourche, La. In charge of survey of Mermenton

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
MAJORS. (continued.)	
James B. Quinn	River, including its tributaries and course through Lake Arthur and Grand Lake to the Gulf of Mexico, La., and examination of Bayou Carlin, La., and Sabine River, Tex. In charge of removal of wreck of bark *Bruce*, in the harbor of Ship Island, Miss. To report upon the depth and width of a channel secured and maintained by jetties at the mouth of the Mississippi River. Member of Board of Engineer Officers to consider and report upon the harbor lines of Portage Lake, Mich.; at Duluth, Minn., the Bay of St. Louis, Superior Bay, and adjacent waters; on improving the harbor at Sabine Pass, Tex.; and upon a project for a lock at the mouth of Bayou Plaquemine, La. Engineer seventh and eighth light-house districts.
Daniel W. Lockwood ..	In charge of the improvement of Little Kanawha, Guyandotte, and Buckhannon rivers, W. Va., Big Sandy River and Tug Fork of Big Sandy River, W. Va. and Ky.; of the Kentucky, Tradewater, Green, and Barren rivers; Levisa Fork of Big Sandy River, and Rough River from mouth to Hartford, and of Licking River from Farmers to West Liberty, Ky. In charge of examination of Russell Fork of Big Sandy River, Green River above the mouth of Big Barren River, and Big Barren River above Bowling Green, Ky. In charge of removal of wreck of a barge in Kentucky River below Lock No. 2. To exercise supervision over the construction of the proposed road of the Carrollton or Lock No. 1 Turnpike Company through the land of the United States at Lock No. 1, Kentucky River; of bridges across the Kentucky River at or near Tyrone and near the mouth of Tates Creek; across the North Fork of Kentucky River above Beattyville, Ky.; and of two bridges across the Tug Fork of the Big Sandy River above Catlettsburg, Ky. Member of Board of Engineer Officers to examine and report upon plans for a bridge proposed to be built across Great Kanawha River at Charleston, W. Va.; on bridge across West Channel of Ohio River at Bridgeport, Ohio; to consider and report upon the subject of harbor lines at Pittsburg, Pa., and on the Ohio to Davis Island Dam; on both sides of the Ohio River from the upper end of Martins Ferry to the city of Bellaire, Ohio; and at Cincinnati, including the Licking River between its mouth and the bridge of the Louisville and Nashville Railroad; the dam to be built in the Big Sandy River near Louisa, Ky.; and a lock, dam, and abutment at Lock and Dam No. 1, Cumberland River.
Ernest H. Ruffner.....	In charge of the improvement of the Mississippi River between Des Moines Rapids and the mouth of the Illinois River. In charge of examination of the Mississippi River at Warsaw, Ill. Members of Boards of Engineer Officers to establish the harbor lines in Quincy Bay, Ill; to consider and report upon a project for closing Hickory Chute, Mississippi River, and upon the reopening of Willow Slough, Mississippi River.
CAPTAINS.	
John C. Mallery	Detached; Engineer fifth and sixth light-house districts.
Clinton B. Sears.....	Commanding Company A, Battalion of Engineers. Instruction in submarine mining at the U. S. Engineer School. Inspecting the troops of the Pennsylvania National Guard at Mount Gretna, Pa., July 23 to 27, 1890. Member of general court-martial convened at Willets Point, N. Y., September 11, 1890. In temporary command of Post of Willets Point, N. Y., May 19 to June 3, 1891.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Thomas Turtle	In charge of the fourth and fifth divisions, Office of the Chief of Engineers. Disbursing Officer, Office of the Chief of Engineers. Member of Board of Engineer Officers to consider and report upon the subject of the dam to be built in the Big Sandy River near Louisa, Ky. Member of the United States Board of Geographic Names.
Edward Maguire	In charge of the Louisville and Portland Canal. In charge of the improvement of the Falls of the Ohio River, the Indian Chute Fall, Ohio River, Wabash River, Ind. and Ill., and White River, Ind. In charge of examination of Wabash River from Terre Haute to La Fayette, Ind. To exercise supervision over the construction of bridge across the Ohio River at Louisville, Ky. Member of Boards of Engineer Officers to examine and report upon plans for a bridge proposed to be built across Great Kanawha River at Charleston, W. Va.; and on bridge across West Channel of Ohio River at Bridgeport, Ohio. On sick leave of absence.
Frederick A. Mahan ...	Detached; Engineer fourth light-house district. Engineer Secretary of the Light-House Board, temporarily.
Charles F. Powell	Secretary and Disbursing Officer of the Mississippi River Commission created by act of Congress approved June 28, 1879. Secretary and assistant to the Construction Committee of the Mississippi River Commission and disbursing officer for works carried on by the Commission. In charge of the improvement of Missouri River from the Great Falls to Sioux City. In charge of the improvement of the Yellowstone River, Mont. and N. Dak. In charge of examination and survey of Missouri River between Great Falls and cañon next below Stubbs Ferry; between Sioux City and Fort Benton, Mont.; and from mouth of Big Sioux River to the north line of South Dakota, Nebraska and South Dakota, and examination of Tongue River, and Yellowstone River from mouth to the Tongue River, Mont.
Frederick A. Hinman..	Found incapacitated for active service by an Army Retiring Board and granted indefinite leave of absence on account of disability. Retired from active service February 26, 1891, under provisions of section 1251, Revised Statutes.
John G. D. Knight	In charge of the first and second divisions, Office of the Chief of Engineers. Member of Board of Officers to test range and position finders.
Richard L. Hoxie	Commanding Company B, Battalion of Engineers. Instructor in Astronomy and in Military Engineering at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., June 8, 1891.
William L. Marshall...	In charge of the improvement of the harbors at Chicago and Calumet, Ill. In charge of the improvements of the Illinois and Calumet rivers. In charge of the construction of the Illinois and Mississippi Canal. In charge of the examination and of survey of the Illinois River from La Salle to the Mississippi River. Member of Boards of Engineer Officers to consider and report upon the harbor lines in Portage Lake, Mich.; at Duluth, Minn.; the Bay of St. Louis, Superior Bay, and adjacent waters; on proposed bridge across the Mississippi River at Clinton, Iowa; and to investigate and report upon the alleged obstructions of navigation by a bridge over the Chicago River at Chicago, Ill. Member of Board of Officers on World's Columbian Exposition. Engineer officer, Division of the Missouri.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Joseph H. Willard.....	In charge of the improvement of Tensas River and Bayou Macon, La., Ouachita and Black rivers and Bayou Bartholomew in La. and Ark., Little River, Bœuf River, Bayous D'Arbonne, Rondeway, and Vidal, La.; Cypress Bayou, La. and Tex.; Red River, La. and Ark., Red River above the Atchafalaya River, Ouachita River above Camden, Ark.; North Fork and main river of the Forked Deer River, and South Forked Deer River, and the Big Hatchie River, Tenn.; of the rivers Big Sunflower, Yazoo, Big Black, and Tallahatchie, Tchula Lake, and Steels and Washington bayous, Miss. In charge of survey of Yazoo River, Miss., Red River from Fulton, Ark., to the Atchafalaya River, La., and Cypress Bayou, and the lakes between Jefferson, Tex., and Shreveport, La., and examination of Cane River and Bayou Castor, La. In charge of the water gauges on the Lower Mississippi River and its principal tributaries. To supervise the construction of the bridge across Yazoo River, near Greenwood, Miss.; and of bridge across the Tensas River at Clayton's Plantation, La.; of bridge across Little River; of bridge across Bœuf River about 3 miles northward of Rayville; of bridge across Red River at Upper Falls near Alexandria, and of bridge across Ouachita River near Columbia, La.; and to supervise changes and alterations in the bridge across Big Black River at Allens Station, Miss. Member of Board of Engineer Officers to consider and report upon the plan and location for a bridge across Red River near Alexandria, La.
Philip M. Price.....	In charge of the defensive works at Forts McRee, Pickens, and Barrancas, Fla. In charge of the improvement of Pensacola and Apalachicola harbors, Fla. In charge of the improvement of the rivers Coosa and Chattahoochee, Ga. and Ala., Flint, Ga., Choctawhatchee, Escambia, and Conecuh, Fla. and Ala., Alabama, Cahawba, and Tallapoosa, Ala., Apalachicola River and La Grange Bayou—improving Holmes River, Fla. In charge of examination Chattahoochee River between West Point and Franklin, Ga. and Ala., and Alabama River from mouth to Wetumpka, Ala. To supervise the construction of bridge across the Alabama River near Montgomery, Ala. Member of Board of Engineer Officers on improvement of Pensacola Harbor, Fla.
Carl F. Palfrey.....	Secretary and Disbursing Officer of the Mississippi River Commission created by act of Congress approved June 28, 1879. Secretary and assistant to the Construction Committee of the Mississippi River Commission and disbursing officer for works carried on by the Commission.
William H. Bixby	In charge of the defensive works at Forts Macon and Caswell, N. C. In charge of the improvement of Beaufort Harbor, N. C., and Georgetown Harbor, S. C. In charge of the improvement of Staunton River, Va., Cape Fear River above and below Wilmington, Roanoke, Neuse, Pamlico, Tar, Yadkin, Black, Trent, New, North East (Cape Fear), Lockwood's Folly, and Pasquotank rivers, Contentnia, Mackeys, and Fishing creeks, Ocracoke Inlet, and inland water way from New Berne to Beaufort, inland water way between Beaufort Harbor and New River, and water way between New River and Swansboro, N. C., and Winyaw Bay, S. C. In charge of examination of Washington Harbor (Pamlico River),

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
William H. Bixby	White Oak River from Roberts Landing to Collins Crossing, Drum Inlet, water way from Pungo River to Sladesville, and water way between Pamlico River and Bay River, N. C., and Black River from Kingstree to mouth, S. C. In charge of removal of wreck of a schooner in Pamlico River, N. C. To exercise supervision over the construction of a bridge across the Cape Fear River at Fayetteville, N. C. Member of Commission of Engineer Officers on National Harbor of Refuge near the mouth of Delaware Bay. Member of Board of Engineer Officers to consider and report upon complaints about the bridge of the New Bridge Company over the Ashley River near Charleston, S. C.
Henry S. Taber	In charge of the improvement of the Arkansas River—removal of snags, etc.; Arkansas River from Wichita, Kans., to mouth, and of rivers White, St. Francis, Red above Fulton, Little Red, and Petit Jean, Ark., Black, Mo. and Ark.; Cache River, Ark.; Little River and St. Francis River, Mo.; and of removal of rock shoals in Fourche River, Ark. In charge of examination of Red River at railroad bridge, Fulton; of Clarendon and the Lower White River, Ark., and Current River, Mo. In charge of survey of Clarendon and Lower White River, Ark.; to supervise the construction of bridge across the Poteau River, in the Choctaw Nation, near Fort Smith; and of bridges across the Arkansas River in the Indian Territory; at Cummings Landing; at Rob Roy, and at Dardanelle, Ark. Member of Board of Engineer Officers to consider and report upon the plan and location for a bridge across Red River near Alexandria, La.
Eric Bergland.....	Commanding Company C, Battalion of Engineers. Instructor in Civil Engineering at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., September 11, 1890.
William T. Rossell	Detached; Assistant to the Engineer Commissioner of the District of Columbia.
Thomas W. Symons...	In charge of the improvement of harbor at Tillamook Bay, harbor at Yaquina Bay, entrance to harbor at Coos Bay, entrance to harbor at Nehalem Bay, mouth of Siuslaw River, and of Umpqua and Coquille rivers, Oregon; the Upper Columbia and Snake Rivers, Oregon and Wash., the Columbia River from the head of Rock Island Rapids to foot of Priest Rapids, and of the rivers Chehalis, Skagit, Stielaquamish, Nootsack, Snohomish, and Snoqualmie, Wash. In charge examination of Tillamook Bay and Bar, Alsea Bay and River, Coos Bay, Yamhill River from mouth to McMinnville, and Coquille River from Coquille City to Myrtle Point, Oregon, Nooksack, Skagit, Snohomish, D'Wamish, Black, Puyallup, Nasel, North, Grays, Deep, Skamakawa, and Crooked rivers, and Grays Harbor and Bar, and extending up Chehalis River to Montesano, Swinomish Slough connecting Saratoga Passage, Skagit Bay, with Padilla Bay, Shoalwater Bay from entrance to Woodward Landing, Olympia Harbor, and ship canal between Port Townsend Bay, Puget Sound, and Oak Bay, Wash., Upper Snake River between Huntington Bridge and Seven Devils mining district, Idaho, and Clarks Fork of the Columbia River. In charge of survey of the Columbia River from the international boundary to Rock Island Rapids, Tillamook Bay and Bar, Coos Bay, Coquille

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
Thomas W. Symons...	River from Coquille City to Myrtle Point, Oregon, Olympia Harbor, Nasel River, Willapah River from South Bend to Woodward Landing, Gray's Harbor and Bar, and extending up Chehalis River to Montesano, North River, Swinomish Slough connecting Saratoga Passage, Skagit Bay, with Padilla Bay, Wash., and Upper Snake River between the Huntington Bridge and Seven Devils mining district, Idaho. In charge of the removal of wreck of bark *Charles Devens* in Coos Bay, Oregon. To supervise the construction of bridges across Coal Bank Slough, Oregon; across Johns River near Gray's Harbor; across Chehalis River between Aberdeen and Cosmopolis; across D'Wamish River near Seattle, Wash.; and across Clearwater River above Lewiston, Idaho. Member of Boards of Engineer Officers to consider and report on the subject of the harbor lines at Portland and at Astoria Harbor; on harbor of refuge at Port Orford; to formulate and submit a project for improving the mouth of Siuslaw River, Oregon; and on ship canal to connect Lakes Union, Wash., and Samamish with Puget Sound.
Smith S. Leach.....	On duty, under the immediate orders of Lieut. Col. Mansfield, upon the fortifications of Boston Harbor.
Dan C. Kingman.....	In charge of fourth district of the Mississippi River from Warrenton to Head of the Passes, for the purpose of improvement and the construction and repair of levees, to include levees and special work on the river, the improvement of the harbor at New Orleans, the Mississippi River at Natchez and Vidalia, the mouth of Red River, and at the mouth of Bayou Plaquemine, and the rectification of the Red and Atchafalaya rivers at mouth of Red River. In charge of removal of wreck of the Vallette dry dock, the elevator *Leo Gilchrist*, and the steamer *Edward J. Gay* in New Orleans Harbor, La. In charge of the defensive works at Forts Porter, Niagara, and Ontario, N. Y. In charge of the improvement of the harbors at Charlotte, Great Sodus Bay, Little Sodus Bay, Oswego, Sacketts Harbor, and Pultneyville, N. Y. In charge of water-level observations on Lake Ontario. Member of Boards of Engineer Officers on building and repair of levees on the Mississippi River; to select the localities and apportion the funds for the construction of levees under the allotment approved by the Secretary of War; and on improvement of Sacramento and Feather rivers, Cal.
Willard Young.....	On leave of absence until February 22, 1891. His resignation as captain, Corps of Engineers, accepted by the President, to take effect February 22, 1891.
William M. Black.....	In charge of the defensive works at Forts Marion and Taylor, Fla. In charge of the improvement of the harbors at Key West, including entrance thereto, Tampa Bay, Cedar Keys, and St. Augustine, Fla. In charge of the improvement at the St. Johns River, Volusia Bar, Caloosahatchee, Manatee, Withlacoochee, Suwanee, and Pease Rivers; channel of Charlotte Harbor, and Pease Creek, Ocklawaha River, and Sarasota Bay, Fla. In charge of examination of Charlotte Harbor, Peace River, Boat or Number Four Channel, Indian River between Titusville and Jupiter Inlet, St. Johns River from Jacksonville to Sanford, the Upper St. Johns River from Lake Monroe southward, and for deep-sea channel over the outer and

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS. (continued.)	
William H. Black.....	inner bar, St. Augustine, Fla. In charge of removal of wreck of German brig from St. Johns River between its mouth and Lake George. Member of Boards of Engineer Officers to establish the harbor lines in St. Augustine Harbor, Fla.; on improving the harbor at Sabine Pass, Tex.; and on improvement of Pensacola Harbor, Fla.
Walter L. Fisk.....	In charge of the defensive works at Forts Jackson, St. Philip, Livingston, Pike, and Macomb, Tower Dupré, Battery Bienvenue, and Tower at Proctorsville, La. In charge of the improvement of the Amite River and Bayou Manchac, Tickfaw, Tchefuncte, and Bogue Falia rivers, mouth and passes of Calcasieu River, bayous Terre Bonne and Courtableau, and Bayou Teche from mouth to St. Martinsville, La., harbor at Sabine Pass, Blue Buck Bar, and Neches River, Tex., and Sabine River, La. and Tex., Bayou Plaquemine, for securing a navigable channel up to Plaquemine Dike, and of Bayou La Fourche, La. In charge of examination of Bayou Terre Bonne from Houma to Thibodeaux, Bayou Black to connect with Terre Bonne, Berwick Bay to the Gulf, Bayou Teche from St. Martinsville to Port Barre, bay and passes of Bayou Vermillion, Bayou Black for connecting Calcasieu Lake and Sabine Lake, Bayou des Glaises, Bayou Cocodrie in St. Landry Parish, shoals on Lake Pontchartrain near the Rigolets, and Bayou Chevreuil and Bayou Tigre from Lake Des Allemands to points near Vacherie, Chigby and Malagay settlement in St. James Parish, La., and Sabine River, Tex.; and examination and survey of Mermenton River, including its tributaries and course through Lake Arthur and Grand Lake to the Gulf of Mexico, La. To report upon the depth and width of a channel secured and maintained by jetties at the mouth of the Mississippi River. Engineer seventh and eighth light-house districts. In charge of the improvement of the harbors of Duluth, Grand Marais, Agate Bay, Minn., Superior Bay on Lake Superior, St. Louis Bay, and Ashland, Wis., Ontonagon, Eagle Harbor, and Marquette, harbor of refuge at Grand Marais, Mich., and of Minnesota Point at Superior, Wis. In charge of survey of St. Louis River, Minn.; resurvey of Marquette Harbor, and resurvey and relocation of harbor line in Portage Lake, Houghton County, Mich. In charge of water level observations on Lake Superior. In charge of the establishment of reference marks for harbor lines in Portage Lake, Mich. To exercise supervision over construction of bridge across the St. Louis River between the States of Minnesota and Wisconsin.
Solomon W. Roessler ..	In charge of first district of the Mississippi River from Cairo to foot of Island No. 40, and of second district from foot of Island No. 40 to mouth of White River, for the purpose of improvement and the construction and repair of levees. In charge of the examination of the Mississippi River from high-water mark, Lake County, Tenn., to high-water mark, Fulton County, Ky., north and west of Reel Foot Lake, and of Memphis Harbor, Tenn. To exercise supervision over construction of bridge across the Mississippi River at Memphis, Tenn. In temporary charge of third district of the Mississippi River, from mouth of White River to Warrenton, for the purpose of improvement and the construction and repair of levees, to include the improvement of the harbor at Vicksburg, Miss. Member of

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
CAPTAINS (continued.)	
Solomon W. Roessler...	Boards of Engineer Officers on building and repair of levees on the Mississippi River; and to select the localities and apportion the funds for the construction of levees under the allotment approved by the Secretary of War.
George McC. Derby	Detached; on duty at the Military Academy as Instructor in Practical Military Engineering, and in command of Company E, Battalion of Engineers. In charge of the preservation and repairs of Fort Clinton and the batteries at the Military Academy. In charge of waterworks and supply line; Officer in charge of Post School for enlisted men, and Acting Signal Officer at West Point, N. Y. In charge of the construction of a new Gymnasium at West Point, N. Y. In charge of the erection of a monument at Washington's headquarters at Newburg, N. Y. Member of general court-martial convened at West Point, October 6, 1890.
James L. Lusk	Detached; Assistant to the Engineer Commissioner of the District of Columbia.
Frederic V. Abbot	In charge of the defensive works at Forts Moultrie, Sumter, and Johnson, and Castle Pinckney, S. C. In charge of the improvement of the harbor at Charleston, S. C. In charge of the improvement of Lumber River, and of Waccamaw River to Waccamaw Lake, N. C. and S. C.; of the Ashley, Edisto, Salkiehatchie, Little Pee Dee, Great Pee Dee, Santee, Wateree, Congaree, Clarks, and Beaufort rivers, Mingo Creek, and Wapoo Cut, S. C. In charge of examination of Wateree River, from Camden to the falls of the Catawba, S. C. In charge of removal of wreck of vessel, name unknown, from bar channel in Charleston Harbor, S. C. Member of Board of Engineer Officers to consider and report upon complaints about the bridge of the New Bridge Company over the Ashley River near Charleston, S. C.
Thomas L. Casey	In charge of the improvement of Keyport Harbor, N. J., and harbor at Canarsie Bay, N. Y. In charge of the improvement of Arthur Kill between Staten Island and the New Jersey shore, N. Y. and N. J. In charge of the improvement of the rivers Shrewsbury, Rahway, Elizabeth, South, Raritan, and Passaic, above and below Newark, mouth of Squan River, Shoal Harbor, and Comptons Creek, and Mattawan Creek, N. J.; Sheepshead and Canarsie bays, and Sumpawanus Inlet, N. Y.; and channel between Staten Island and New Jersey. In charge of examination of Princess Bay, N. Y., and of examination and survey of Hackensack River, from below the Newark and New York Railroad Bridge, on Newark Bay, to the town of Hackensack, N. J. In charge of removal of wreck of barge *Nellie* in the entrance to Arthur Kill, at Elizabethport, N. J. To supervise the work of dredging and filling riprap, dock, and crib work for the improvement of Ellis Island, N. Y. Harbor; the use of the United States dike on Newark Bay front, and the construction of bridge across Newark Bay at Newark, N. J. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines in Stamford Harbor, and at Bridgeport, Conn. Member of Board of Officers appointed for the purpose of testing the Berdan range-finder and such other range-finders as may be recommended for test by the Board of Ordnance and Fortification.
Theodore A. Bingham..	Detached; military attaché to the United States legation at Berlin.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

BANK AND NAME.	DUTIES.
CAPTAINS (continued.)	
Curtis McD. Townsend.	In charge of third district of the Mississippi River, from mouth of White River to Warrenton, for the purpose of improvement and the construction and repair of levees, to include the improvement of the harbor at Vicksburg, Miss. Member of Board of Engineer Officers on building and repair of levees on the Mississippi River.
Gustav J. Fiebeger	In charge of the improvement of the harbor at Norfolk, and the approach to Norfolk Harbor and the United States navy-yard, Va. In charge of the improvement of the Appomattox, Chickahominy, and Nansemond rivers, including mouths of Bennett and Chuckatuck creeks, and of Hampton Creek and Bar, Va., North Landing River, and inland water route from Norfolk Harbor, Va., to Albemarle Sound, N. C., through Currituck Sound, Va. and N. C., Currituck Sound, Coanjok Bay, and North River Bar, N. C. In charge of examination of water way to connect Lynn Haven Bay with the eastern branch of Elizabeth River, Nottoway River from mouth to Courtland, western branch of Elizabeth River, Chickahominy and West Neck rivers, Va., and Northwest River up to Moyock, N. C. Member of Boards of Engineer Officers to consider and report upon the subject of harbor lines of Norfolk and Portsmouth Harbors and their adjacent waters; and in James River from Richmond to City Point, Va.
Oberlin M. Carter	In charge of the defensive works at Forts Oglethorpe and Pulaski, Ga., and Clinch, Fla. In charge of the improvement of the harbors at Savannah, Brunswick, and Darien, Ga. In charge of the improvement of Cumberland Sound, Ga. and Fla., Savannah, Altamaha, Ocmulgee, and Oconee rivers, and Jekyl Creek, and Romerly Marsh, Ga. In charge of examination and of survey of the inside route between Savannah, Ga., and Fernandina, Fla., the inside route between Doboy and Sopelo, and Brunswick Outer Bar, and examination of Yellow River, Ga. In charge of removal of wrecks of steamers *Habersham*, *Milledgeville*, and *General Lee;* barge and two flat boats in Savannah River and Harbor; and of wreck of an old vessel in Savannah River, Ga. To exercise supervision over the construction of two bridges across the Oconee River at or near Dublin; of bridge at Dublin; and of bridge across Savannah River at or near "Sisters Ferry," Ga. Member of Boards of Engineer Officers to establish the harbor lines in St. Augustine Harbor, Fla.; to consider and report upon complaints about the bridge of the New Bridge Company over the Ashley River near Charleston, S. C.; and on improvement of Pensacola Harbor, Fla.
FIRST LIEUTENANTS.	
George W. Goethals ...	On duty under the immediate orders of Lieutenant-Colonel Barlow. In charge of the improvement of Tennessee River from Chattanooga to the foot of Bee Tree Shoals.
John Millis.....	Detached; on light-house duty under the immediate orders of Major Heap. In charge of fourth district of the Mississippi River, from Warrenton to Head of the Passes, for the purpose of improvement and the construction and repair of levees, to include levees and special work on the river, the improvement of the harbor at New Orleans, the Mississippi River at Natchez and Vidalia, the mouth of Red River, and at the mouth of Bayou Plaquemine, and

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
John Millis	the rectification of the Red and Atchafalaya rivers at mouth of Red River. In charge of removal of wreck of the Vallette Dry Dock, the elevator *Leo Gilchrist*, and the steamer *Edward J. Gay*, in New Orleans Harbor, La. Member of Boards of Engineer Officers on building and repair of levees on the Mississippi River; and to select the localities and apportion the funds for the construction of levees under the allotment approved by the Secretary of War.
John Biddle	Detached; on duty as Assistant Instructor in Practical Military Engineering at the Military Academy, and with Company E, Battalion of Engineers. Recruiting Officer for Company E, Battalion of Engineers. Officer in charge of Post School for soldiers' children. Temporarily in command of Company E, Battalion of Engineers, and in charge of the preservation and repairs of Fort Clinton and the batteries at the Military Academy; of waterworks and supply line, and Officer in charge of Post School for enlisted men at West Point, N. Y.; of the charge of the construction of a new Gymnasium at West Point, N. Y., and of the erection of a monument at Washington's headquarters at Newburg, N. Y. On duty under the immediate orders of Lieutenant-Colonel Barlow.
Harry F. Hodges	Detached; on duty at the Military Academy as Assistant Professor in Civil and Military Engineering. On temporary duty under the immediate orders of Colonel Poe. Member of general court-martial convened at West Point, N. Y., Nov. 14, 1890.
James G. Warren	Adjutant and Treasurer of the Battalion of Engineers and Post of Willets Point, and Signal Officer and Recruiting Officer, Post of Willets Point. Commanding Company D, Battalion of Engineers. Inspector of small-arms practice, Battalion of Engineers. In charge of property pertaining to the library of the U. S. Engineer School. Inspecting the troops of the Pennsylvania National Guard at Mount Gretna, Pa., July 16–21, 1890.
Edward Burr	On duty under the immediate orders of Major Handbury. Member of Board of Engineer Officers to formulate and submit a project for improving the mouth of Siuslaw River, Oregon.
Lansing H. Beach	Detached; on duty at the Military Academy in Department of Civil and Military Engineering. Member of general court-martial convened at West Point Oct. 6, 1890.
Graham D. Fitch	On duty under the immediate orders of Major Quinn. In temporary charge of the improvement of the harbors of Duluth, Grand Marais, Agate Bay, Minn., Superior Bay on Lake Superior, St. Louis Bay, and Ashland, Wis., Ontonagon, Eagle Harbor, and Marquette, Mich., harbor of refuge at Grand Marais, Mich., and of Minnesota Point at Superior, Wis.; of survey of St. Louis River, Minn.; resurvey of Marquette Harbor, and resurvey and relocation of harbor line in Portage Lake, Houghton County, Mich.; of water-level observations on Lake Superior, and the establishment and maintenance of harbor lines in Portage Lake, Mich. To exercise supervision, temporarily, over construction of bridge across the St. Louis River between the States of Minnesota and Wisconsin. On duty under the immediate orders of Captain Symons.
Eugene J. Spencer	On duty under the immediate orders of Captain Abbot. On leave of absence until Aug. 12, 1890. His resignation as first lieutenant, Corps of Engineers, accepted by the President to take effect Aug. 12, 1890.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
George A. Zinn	Q. M. Battalion of Engineers. A. A. Q. M. and A. C. S., Post of Willets Point. Instructor in Military Photography at the U. S. Engineer School. Judge-advocate of general court-martial convened at Willets Point, N. Y., Sept. 11, 1890. On duty under the immediate orders of Lieutenant-Colonel Hains.
William C. Langfitt	On duty under the immediate orders of Major Allen. Member of Commission of Engineer Officers to consider and report upon the value of a channel constructed by the Buffalo Bayou Ship Channel Company.
Henry E. Waterman	On duty under the immediate orders of Major Davis.
James C. Sanford	Secretary and Disbursing Officer of the Missouri River Commission created by act of Congress approved July 5, 1884.
Hiram M. Chittenden	Detached; in charge of the improvement of the Missouri River from Sioux City, Iowa, to Fort Benton, Mont., under the orders of the Missouri River Commission. On duty under the immediate orders of Major Jones.
Cassius E. Gillette	On duty under the immediate orders of Lieutenant-Colonel Merrill. Member of Boards of Engineer Officers to consider and report upon the subject of the harbor lines at Pittsburg, Pa., and on the Ohio to Davis Island Dam; on both sides of the Ohio River from the upper end of Martins Ferry to the lower end of the city of Bellaire, Ohio, and at Cincinnati, including the Licking River between its mouth and the bridge of the Louisville and Nashville Railroad.
David DuB. Gaillard	On duty under the immediate orders of Captain Black. Member of Board of Engineer Officers to establish the harbor lines in St. Augustine Harbor, Fla.
Harry Taylor	On duty under the immediate orders of Lieutenant-Colonel Gillespie.
William L. Sibert	On duty under the immediate orders of Major Lockwood.
Joseph E. Kuhn	Detached; on duty at the Military Academy in Department of Civil and Military Engineering. Member of general court-martial convened at West Point, Nov. 14, 1890.
William E. Craighill	On duty under the immediate orders of Major Jones. On duty under the immediate orders of Captain Price.
Henry C. Newcomer	On duty under the immediate orders of Colonel Mendell.
Mason M. Patrick	On duty under the immediate orders of Captain Bixby. In temporary charge of the defensive works at Fort Macon and Caswell, N. C. In temporary charge of the improvement of Beaufort Harbor, N. C., and Georgetown Harbor, S. C. In temporary charge of the improvement of Cape Fear River above and below Wilmington, Roanoke, Neuse, Pamlico, Tar, Yadkin, Black, Trent, New, North East (Cape Fear), Lockwoods Folly, and Pasquotank rivers, Contentnia, Mackeys, and Fishing creeks, Ocracoke Inlet, and inland water way from New Berne to Beaufort, inland water way between Beaufort Harbor and New River, and water way between New River and Swansboro, N. C., and Winyaw Bay, S. C. In temporary charge of examination of Washington Harbor, Pamlico River, White Oak River from Roberts Landing to Collins Crossing, Drum Inlet, water way from Pungo River to Sladesville, and water way between Pamlico River and Bay River, N. C., and Black River from Kingstree to mouth, S. C. To exercise supervision temporarily over the construction of bridge across the Cape Fear River at Fayetteville, N. C.
Charles S. Riché	On duty under the immediate orders of Colonel Poe.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
FIRST LIEUTENANTS. (continued.)	
Thomas H. Rees	On duty under the immediate orders of Captain Carter.
Charles L. Potter.....	On duty under the immediate orders of Captain Price. Competitor in the annual rifle competitions at Fort Niagara, N. Y. On temporary duty at Willets Point, N. Y. On duty under the immediate orders of Colonel Mendell.
Francis R. Shunk.....	On duty with Company B, Battalion of Engineers. Officer in charge of Post Schools, Post of Willets Point, N. Y. Acting Ordnance Officer, Post of Willets Point, N. Y. Assistant Instructor in Submarine Mining at the U. S. Engineer School. Member of Electrical Board for the District of Columbia.
Eugene W. VanC. Lucas	On duty with Company A, Battalion of Engineers. On duty, temporarily, with Company E, Battalion of Engineers. Detached; on duty with Company E, Battalion of Engineers, at the Military Academy. Recruiting officer Company E, Battalion of Engineers.
SECOND LIEUTENANTS.	
James J. Meyler	On duty under the immediate orders of Lieutenant-Colonel Benyaurd.
Henry Jervey	On duty with Company B, Battalion of Engineers. In charge of Post Canteen, post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Q. M. Battalion of Engineers. A. A. Q. M. and A. C. S., post of Willets Point. Instructor in Military Photography at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., Sept. 11, 1890.
Charles H. McKinstry .	On duty with Company C, Battalion of Engineers. Mess Officer, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., Sept. 11, 1890. Detached; on duty with Company E, Battalion of Engineers, at the Military Academy.
William V. Judson	On duty with Company A, Battalion of Engineers. Officer in charge of Post Schools, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. On duty under the immediate orders of Major Overman.
Eben E. Winslow.....	On duty with Company B, Battalion of Engineers. Officer in charge of Post Schools, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., June 8, 1891.
Albert M. D'Armit.....	On duty with Company C, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., Sept. 11, 1890.
Clement A. F. Flagler.	On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School. Judge-Advocate of general court-martial convened at Willets Point, N. Y., June 8, 1891.
Chester Harding	On duty with Company B, Battalion of Engineers. In charge of Post Canteen, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., Sept. 11, 1890.
William W. Harts.....	On duty with Company C, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., June 8, 1891.

Statement showing rank and duties of officers of Corps of Engineers—Cont'd.

RANK AND NAME.	DUTIES.
SECOND LIEUTENANTS. (continued.)	
Robert McGregor.....	On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., June 8, 1891.
ADDITIONAL SECOND LIEUTENANTS.	
Edgar Jadwin.....	On duty under the immediate orders of Captain Casey. On duty with Company A, Battalion of Engineers. On duty with Company B, Battalion of Engineers. Mess Officer, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School. Member of general court-martial convened at Willets Point, N. Y., June 8, 1891.
Charles Keller.....	On duty with Company A, Battalion of Engineers. On duty with Company C, Battalion of Engineers. Acting Ordnance Officer, Post of Willets Point, N. Y. Under instruction at the U. S. Engineer School.
Herbert Deakyne.....	On duty with Company B, Battalion of Engineers. On duty with Company A, Battalion of Engineers. Under instruction at the U. S. Engineer School.
Charles S. Bromwell...	On duty with Company C, Battalion of Engineers. On duty with Company B, Battalion of Engineers. Under instruction at the U. S. Engineer School.
U. S. AGENTS.	
S. T. Abert.....	In charge of the improvement of the harbor at Breton Bay, Leonardtown, and at entrance of St. Jerome Creek, Md. In charge of the improvement of Patuxent River, Md.; of the rivers Rappahannock, Chickahominy, Mattaponi, Totusky, York, Pamunky, and Staunton, Va., and Dan, Va. and N. C.; of channel in Potomac River through flats in front of landing at Mount Vernon, and of Nomini Creek, Va.
William F. Smith, *Major of Engineers, U. S. A., Retired.*	In charge of the improvement of the harbors at Wilmington, Del., Cambridge, Md., Onancock and Cape Charles City and Chenton Inlet, Va., and ice harbor at New Castle, Del. In charge of the improvement of the Maurice River, N. J., Broadkiln, St. Jones, Appoquinnimink, and Smyrna rivers, and Duck and Mispillion and Broad creeks, Del., Susquehanna River, Md. and Pa., Choptank, Wicomico, Manokin, Chester, Elk, and North East rivers, and of Fairlee Creek or Inlet, Md., and inland water way from Chincoteague Bay, Va., to Delaware Bay at or near Lewes, Del. In charge of examination of Murderkill, Broad Creek, and Mispillion rivers, Del., La Trappe, Turners Creek, Rock Hall Harbor, Nanticoke River, the northwest fork of same, Linchester River, Susquehanna River, above Havre de Grace, Broad Creek, and Warwick, Md., and Tangier Harbor, Va. In charge of survey to locate the canal between Rehoboth Bay and Delaware Bay—a part of the proposed water way from Chincoteague Bay, Va., to Delaware Bay; of Murderkill and Mispillion rivers, Del., Rock Hall Harbor, Susquehanna River above Havre de Grace, La Trappe and Warwick rivers, and Broad and Turner creeks, Md. In charge of removal of wrecks of schooners *Maria Green* in Jacksons Creek, Chester River, Md., and of *Mary A. Rhodes* in Smyrna River, Del.
U. S. CIVIL ENGINEER.	
M. Meigs.....	On duty under the immediate orders of Major Mackenzie.

LAWS

AFFECTING

THE CORPS OF ENGINEERS,

UNITED STATES ARMY,

FIFTY-FIRST CONGRESS, SECOND SESSION.

1890-'91.

LAWS

AFFECTING

THE CORPS OF ENGINEERS, UNITED STATES ARMY.

FIFTY-FIRST CONGRESS, SECOND SESSION, 1890–'91.

PUBLIC ACTS.

CHAP. 3.—An act to authorize the Lake Charles Road and Bridge Company, of Lake Charles, Louisiana, to construct and maintain bridges across English Bayou and Calcasieu River. December 11, 1890.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the Lake Charles Road and Bridge Company, a corporation created and existing under and by virtue of the laws of the State of Louisiana, or its assigns, to erect, construct, and maintain a bridge over the English Bayou and a bridge over Calcasieu River, in the State of Louisiana, at such points upon said bayou and river in township nine south and range eight west as may be found advantageous. Said bridges shall be constructed to provide for the passage of wagons and vehicles of all kinds, for the transit of animals, foot-passengers, and of all kinds of commerce, travel, or communication, and said corporation may charge and receive such reasonable tolls therefor as may be approved from time to time by the Secretary of War.

Lake Charles Road and Bridge Company may bridge English Bayou and Calcasieu River at certain points in Louisiana.

Location.

Wagon, etc., and footbridges.

Tolls.

SEC. 2. That each of said bridges shall be constructed as draw-bridges, with an opening over the center of the channel of such width as the Secretary of War shall determine, and which shall not be less than thirty feet in the clear across English Bayou and not less than fifty feet in the clear across Calcasieu River: *Provided, also*, That said draws shall be opened promptly upon reasonable signal for the passage of boats, vessels, or other water-craft, and in no case shall unnecessary delay occur; and said company or corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridges as the Light-House Board shall prescribe, and such sheer booms or other structures as may be necessary to safely guide vessels, boats, rafts, or other water-craft safely through said draw-openings as shall be designated and required by the Secretary of War.

Construction.

Draws.

Width.

Proviso.

Opening of draws.

Lights, etc.

Sheer booms, etc.

SEC. 3. That said bridges shall be built and located under and subject to such regulations for the security of navigation of said bayou and river as the Secretary of War shall prescribe, and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridges and a map of the location, giving for the space of one mile above and one mile below the proposed location the topography of the banks of the bayou and river, the shore-lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed of the streams, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plans and locations are approved by the Secretary of War the bridges shall not be built, and

Security of navigation.

Secretary of War to approve plans, etc.

Changes in plans. should any changes be made in the plans of said bridges during the progress of construction such change shall be submitted to the approval of the Secretary of War.

Amendment, etc. SEC. 4. That the right to alter, amend, or repeal this act, or to require any changes in such structures, or their entire removal at the Structural changes. expense of the owners thereof, whenever the Secretary of War shall decide that the public interest requires it, and the right to prescribe Regulations, etc. such rules and regulations in regard to toll and otherwise as may be deemed reasonable, are expressly reserved.

Commencement and completion. SEC. 5. That this act shall be null and void if actual construction of the bridges herein authorized be not commenced within one year and completed within three years from the date thereof.

Approved, December 11, 1890.

December 26, 1890. **CHAP. 33.**—An act authorizing the city of Albany, in the county of Linn, State of Oregon, to construct a bridge across the Willamette River, in said State.

Albany, Linn Co., Oregon, may bridge Willamette River at Albany, Oregon. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the city of Albany, in the county of Linn, State of Oregon, be authorized and permitted to build a wagon and foot bridge across the Willamette River, at such point as may be selected opposite the said city, and between the counties of Linn and Benton, in said State of Oregon. Such bridge may also, at Wagon and foot, or wagon, foot, and railroad bridge. the option of said city, be so constructed as to be available as a railroad bridge: *Provided*, That in either case said bridge shall not interfere with the free navigation of said river, and in case of any litigation Free navigation. arising from any obstruction, or alleged obstruction, to the free navigation of said river by reason of the construction of said bridge, the cause may be tried before the circuit court of the United States in and Litigation. for the district in whose jurisdiction any portion of said obstruction or bridge may be.

Construction optional. SEC. 2. That such bridge, built under the provisions of this act, may, at the option of the city of Albany, be built as a draw-bridge, or with unbroken, continuous spans, *provided*, if such bridge shall be made with *Provisos.* Spans. unbroken, continuous spans the main span shall be over the main channel of such navigable river, and shall be of such width and the lowest part of the superstructure shall be of such height above extreme high-water mark as the Secretary of War may prescribe, and such bridge Piers. shall be at right angles to, and its piers parallel with, the channel or Draw-bridge opening. current of said river. And if such bridge, built under this act, shall be constructed as a draw-bridge the same shall be constructed with the opening over the center or channel of the river, and shall be of such Width, etc. width and character of construction as the Secretary of War shall prePiers. scribe, and the piers of such bridge shall be parallel with the current, Draw. and the draw of such bridge shall be over the main or deep channel of Opening of draw. the river: *Provided also*, That said draw shall be opened promptly upon a reasonable signal for the passage of boats, and in no case shall unnecessary delay occur in opening said draw.

Lights, etc. And said city of Albany shall maintain at its own expense, from sunset to sunrise, such lights or other signals on such bridge as the Light-*Proviso.* House Board shall prescribe: *Provided also*, That said bridge, at the option of the said city of Albany, may be used for the passage of wagons or vehicles of all kinds, for the transit of animals and foot passengers for such reasonable rate of toll as may be approved from time to Optional toll or free bridge. time by the Secretary of War, but the same may, at the option of the city of Albany, be a free bridge for the passage of vehicles and foot passengers thereon.

Lawful structure and post-route. SEC. 3. That the bridge authorized to be constructed under this act shall be a lawful structure, and shall be recognized and known as a post-route, and shall enjoy the rights and privileges of other post-roads in the United States, and no higher charge shall be made for Railroad charges. the transmission over the same of the mails, troops, or munitions of war of the United States or for other passengers or freight passing over said bridge than the rate per mile paid for transportation over any railroad leading to said bridge. And the United States shall have Postal telegraph. the right of way for a postal telegraph across said bridge and its approaches.

Said bridge shall be built and located under and subject to such regulations for the security of navigation on navigable rivers as the Secretary of War shall prescribe. To secure that object the said city of Albany shall submit to the Secretary of War, for his examination and approval, a design and drawing of such bridge, and a map of the location, giving, for the space of one mile above and one mile below the location, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed and channel of the stream, and the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject. And until the said plans and location of the bridge are approved by the Secretary of War the bridge shall not be built, and any change made in the plans of such bridge during the progress of the work thereon shall be subject to the approval of the Secretary of War.

Security of navigation.

Secretary of War to approve plans, etc.

Change in plan.

SEC. 4. That such alterations or changes as may be required by the Secretary of War or Congress in the bridge constructed under the provisions of this act shall be made by the said city of Albany at its own expense, and at any time after the completion of such bridge the said city of Albany may, at its option, surrender and transfer to the counties of Linn and Benton, in the State of Oregon, said bridge and the entire control and management thereof, in which event and in case of the acceptance thereof by said counties they shall thereafter be subject to all the obligations and conditions imposed upon the city of Albany by the provisions of this act.

Structural changes.

Optional transfer, etc., to Linn and Benton counties, etc.

SEC. 5. That said city of Albany, or any county or counties, corporation, or persons owning, controlling, or operating the bridge built under the authority of this act shall build and maintain at all times as accessory works to said bridge such booms, piers, dikes, guard-fences, and similar devices as may be necessary to insure at all times a permanent channel for a sufficient distance above and below the bridge site, and for guiding of rafts, steamboats, and other watercraft safely under or through said bridge, as may be prescribed by the Secretary of War.

Aids to navigation.

SEC. 6. That in case the bridge authorized by this act shall be constructed to provide for the passage of railroad trains, then all railroad companies desiring the use of the bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains or cars over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties; and equal privileges in the use of said bridge and approaches shall be granted to all telegraph and telephone companies.

Use by railroad companies.

Terms.

Use by telegraph, etc., companies.

SEC. 7. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within two years and completed within four years from the date of approval thereof.

Commencement and completion.

SEC. 8. That the right to alter, amend, or repeal this act is hereby expressly reserved; and the right to require the entire removal of the bridge constructed under the provisions of this act, at the expense of the owners thereof, whenever Congress shall decide that the public interests require it, is also expressly reserved.

Amendment, etc.

Removal.

Approved, December 26, 1890.

CHAP. 34.—An act authorizing the Bowling Green and Northern Railroad Company to bridge Green and Barren Rivers.

December 26, 1890.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the Bowling Green and Northern Railroad Company, a corporation created and existing under and by virtue of the laws of the State of Kentucky, to build or cause to be built a bridge across Green River at a point

Bowling Green and Northern Railroad Company may bridge Green and Barren Rivers, Ky.

Locations. near the mouth of Bear Creek; also one across Barren River near Graham's Landing, or at such other points as may be selected by the

Railway bridges. said railroad company and approved by the Secretary of War, and to lay on or over said bridge or bridges railway tracks, for the more perfect connection of the railway tracks they may hereafter build, to the points to be selected for crossing said rivers.

Draw or span. SEC. 2. That any bridge or bridges built under the provisions of this act may, at the option of said railway company, be built as a draw-

Provisos. bridge or with unbroken or continuous spans: *Provided*, That if any such bridge or bridges shall be built with unbroken and continuous

Spans. spans the spans thereof over and above the channels of said river or

Length, etc. rivers shall not be less than two hundred feet in length in the clear, and the main span or spans shall be over the main channels of the above-mentioned rivers. The lowest part of the superstructure of

Height. said bridges shall be of such height above extreme high-water mark, as understood at the points of location, as the Secretary of War may prescribe, and, if any such bridge is constructed as a low bridge, it

Draw-openings, etc. shall have such clear height and be provided with draw-openings of such width and at such location as shall be prescribed by the Secre-

Piers, etc. tary of War. The bridges shall be at right angles to and their piers parallel with the current of the rivers: *And provided also*, That said

Optional use for wagons and foot-passengers. bridges, at the option of the corporation or company by which they may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals and for foot-passengers, for such

Tolls. reasonable rates of toll as may be approved from time to time by the Secretary of War.

Lawful structures and post-routes. SEC. 3. That any bridge or bridges authorized to be constructed under this act shall be lawful structures, and shall be recognized and known as post-routes, and they shall enjoy all the rights and privileges of other post-roads in the United States, upon which also no

Railroad charges. higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States, or for through passengers or freight passing over said bridge or bridges and approaches, than the rate per mile paid for transportation over

Postal telegraph, etc. the railroads leading to said bridge or bridges; and the United States shall have the right of way for postal telegraph and telephone purposes without charge therefor across said bridge or bridges and approaches.

Said bridge or bridges shall be built and located under and subject

Security of navigation. to such regulations for the security of navigation as the Secretary of War shall prescribe; and to secure that object the said company or

Secretary of War to approve plans, etc. corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge or bridges, and a map of the location or locations, giving, for the space of one mile above and one mile below the proposed location or locations, the high and low water lines upon the banks of the river or rivers, the direction and strength of the current at all stages of the water, with the soundings, accurately showing the bed of the stream, and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge or bridges are approved by the Secretary of

Change in plan. War the bridge or bridges shall not be built, and should any change be made in the plan of said bridge or bridges during the progress of construction or after completion such changes shall be subject to the approval of the Secretary of War.

Amendment, etc. SEC. 4. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said struc-

Removal. ture, or its entire removal, at the expense of the owners thereof, or the corporation or persons controlling the same, whenever the public interest requires it, is also expressly reserved.

SEC. 5. On any bridge or bridges constructed under the provisions of this act there shall be maintained, at the expense of the company or

Lights, etc. corporation owning or controlling the same, such lights and other signals as may be prescribed by the Light-House Board.

Commencement and completion. SEC. 6. That this act shall be null and void if actual construction of the bridges herein authorized be not commenced within one year and completed within three years from the date hereof.

Approved, December 26, 1890.

CHAP. 121.—An act to authorize the Norfolk and Western Railroad Company to bridge the Tug Fork of the Big Sandy River at certain points, where the same forms the boundary line between the States of West Virginia and Kentucky.

February 9, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the Norfolk and Western Railroad Company, a corporation existing under the laws of Virginia and West Virginia, to construct and maintain bridges and approaches thereto across the Tug Fork of the Big Sandy River at such points where the same forms the boundary line between the States of West Virginia and Kentucky as the said company may deem suitable for the passage of its road over the said fork of the Big Sandy River, subject to the approval of the Secretary of War.

Norfolk and Western Railroad Company may bridge Tug Fork of Big Sandy River, between West Virginia and Kentucky.

Location of bridges.

SEC. 2. That any bridge or bridges authorized to be constructed under this act shall be lawful structures, and shall be recognized and known as post routes, and they shall enjoy all the rights and privileges of other post roads in the United States, upon which also no higher charge shall be made for the transmission over the same of the mails, or for through passengers or freight passing over said bridge or bridges and approaches, than the rate per mile paid for transportation over the railroads leading to said bridge or bridges; and the United States shall have the right of way for postal telegraph and telephone purposes without charges therefor across said bridge or bridges and approaches.

Lawful structures and post routes.

Postal telegraph, etc.

Said bridge or bridges shall be built and located under and subject to such regulations for the security of navigation as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge or bridges and a map of the location or locations, giving, for the space of one mile above and one mile below the proposed location or locations, the high and low water lines upon the banks of the river or rivers, the direction and strength of the current at all stages of the water, with the soundings, accurately showing the bed of the stream, and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and should any change be made in the plan of said bridge or bridges during the progress of construction or after completion, such changes shall be subject to the approval of the Secretary of War.

Security of navigation.

Maps, plans, etc.

Change of plan.

SEC. 3. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said structures, or any of them, or their entire removal at the expense of the owners thereof, or the corporation or persons controlling the same, whenever the public interest requires it, is also expressly reserved.

Amendment, etc

Structural changes.

SEC. 4. That on any bridge or bridges constructed under the provisions of this act there shall be maintained, at the expense of the company or corporation owning or controlling the same, such lights and other signals as may be prescribed by the Light-House Board.

Lights, etc.

SEC. 5. That this act shall be null and void if actual construction of the bridges herein authorized be not completed within three years from the date hereof.

Commencement and completion.

Approved, February 9, 1891.

CHAP. 123.—An act to authorize the construction of a bridge across the Cumberland River for the use of the Chesapeake and Nashville Railway, and for other purposes.

February 9, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Chesapeake and Nashville Railway Company, a corporation organized under and pursuant to the laws of the States of Kentucky and Tennessee, or its successors, be, and is hereby, authorized to construct and maintain a bridge over the Cumberland River at such point in Trousdale or Sumner and Wilson or Davidson counties, in the State of Tennessee, as it may select, subject to the approval of the Secretary of War. Said bridge shall

Chesapeake and Nashville Railway Company may bridge Cumberland River at point in Tennessee.

Location.

Railway, or railway, wagon, and foot bridge. Toll.

provide for the passage of railway trains and, at the option of the said company, may be used also for the transit of animals, vehicles of all kinds, and foot passengers, for such reasonable rates of toll as may be approved from time to time by the Secretary of War.

Lawful structure and post route.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure and shall be recognized and known as a post route, and it shall enjoy the rights and privileges of other post roads in the United States, and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge for all purposes.

Telegraph, etc., companies.

Government right of way.

Security of navigation.

SEC. 3. That any bridge authorized by this act shall be located and built subject to such regulations for the security of navigation as the Secretary of War shall prescribe; and to secure that object the said company shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location thereof, giving the high and low water lines upon the banks of the river, the direction and strength of the currents at all stages of the water, with soundings, accurately showing the bed of the stream, and the location of any other bridge or bridges; such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject, and until such plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built, and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War.

Maps, etc.

Approval of location.

Change in plan.

Use by other companies.

SEC. 4. That all railroad companies desiring the use of said bridge shall have equal rights and privileges relative to the passage of railway trains over the same and over the approaches thereto upon the payment of reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any of them, desiring such use shall fail to agree upon the sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Terms.

Failure to agree.

Decision by Secretary of War.

Lights, etc.

SEC. 5. That the Chesapeake and Nashville Railway Company shall maintain on said bridge, at its own expense, from sunset to sunrise, such lights or other signals as the Light-House Board shall prescribe.

Commencement and completion.

SEC. 6. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Amendment, etc.

Structural changes, etc.

SEC. 7. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said structure, or its entire removal, at the expense of the owners thereof, whenever Congress or the Secretary of War shall decide that the public interests require it, is also expressly reserved.

Approved, February 9, 1891.

February 9, 1891.

CHAP. 126.—An act to promote the construction of a safe deep-water harbor on the coast of Texas.

Corpus Christi and Padre Island Harbor Company may construct harbor and bridges at Padre Island, Tex.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Corpus Christi and Padre Island Harbor Company, created and existing under and by virtue of articles of incorporation drawn in accordance with and by authority of the general incorporation act of the State of Texas, and dated December tenth, eighteen hundred and eighty-seven, or its successors or assignees, be, and is hereby, authorized and empowered to construct, at their exclusive cost, as in their charter provided, a sea-wall, breakwaters, and viaduct off the shore of Padre Island, on the coast of Texas, within the jurisdiction of the United States, subject to the terms and conditions herein set forth.

Commencement.

SEC. 2. That said company shall, within two years after the passage of this act, locate and commence the construction of said harbor at a point to be selected by them off Padre Island, coast of Texas. Com-

mencing at the water's edge and running at an angle to the shore they shall construct a viaduct of the most approved modern plan, extending seaward until a depth of, say, twenty-seven feet of water is reached; thence continuing in the same direction they shall construct a sea-wall until thirty feet or more of water is reached; thence turning southward at an angle or curve which shall throw the sea-wall parallel, or nearly so, with the shore-line of Padre Island, they shall construct a sea-wall three thousand feet in length, said sea-wall to be placed upon a base of riprap or other suitable foundation, upon which shall be constructed a wall of concrete of such form of structure as the engineer officer of said company may hereafter adopt, twenty-two feet thick, more or less, and twenty-nine feet high, reaching eleven feet above mean low water. They shall also construct breakwaters of sufficient length and so placed as to protect the shore end of the viaduct, and another of sufficient length and so placed as to protect the entrance to the embayed space, thus forming an outer harbor sufficient in extent to afford dockage for, and accommodation at its wharves for, thirty of the largest ocean steamers afloat and two hundred or more smaller vessels or coasters at one time, and shall complete said work within four years from the commencement of the same. When completed, the embayed space or harbor shall be, and is hereby, declared to be a harbor of refuge for the vessels of all nations and such vessels as may touch for orders, free of charge, except such vessels as may land at the wharves.

Location.
Viaduct.
Depth of water.
Sea-walls.
Length.
Base and wall.
Height, etc.
Breakwaters.
Dimensions, etc., of outer harbor.
Completion.
A free harbor of refuge for vessels.
Exceptions.

SEC. 3. That in consideration of the free use of the embayed space or harbor as a harbor of refuge for the vessels of all nations except vessels which land at and use the wharves, and in further consideration of the vast benefit to the general commerce of the whole country and in lieu of any money appropriations for the improvement of the said coast, the said company shall be allowed to charge and collect such reasonable port charges and wharfage as may be prescribed by regulations that may be made by the Secretary of the Treasury of the United States, in conformity with the laws of the United States.

Port charges and wharfage.
Secretary of the Treasury to regulate.

SEC. 4. That no wharfage or port charges shall be charged until after the said improvement shall have been inspected by a board of three engineers of the United States Army, appointed by the Secretary of War for the purpose, and found to have been fully completed in accordance with the terms of this act and until such report shall have been approved by the Secretary of War.

Charges, etc.
Inspection by Army engineers, etc.

SEC. 5. That the United States Government specially reserves the right at its option to take said works upon payment to the owners thereof the actual value of the same at the time of taking, which value shall be determined by a board of engineers of the United States Army, to be appointed by the Secretary of War for the purpose.

Optional right of Government to take possession, etc.
Determination of value.

SEC. 6. The rights herein granted to the "Corpus Christi and Padre Island Harbor Company" are upon the condition that there shall be no discrimination made in favor of or against any individual or corporation in regard to the use of said harbor or its approaches by land or water.

No discrimination in use of harbor, etc.

SEC. 7. That the said Corpus Christi and Padre Island Harbor Company be, and hereby is, authorized and empowered to construct bridges across Laguna Madre from the main land to Padre Island, in accordance with such plans and specifications as the Secretary of War may approve.

May bridge Laguna Madre.
Location of bridges.
Secretary of War to approve plans.

Approved, February 9, 1891.

CHAP. 164.—An act to authorize the construction of a tunnel under the waters of the bay of New York, between the town of Middletown, in the county of Richmond and the town of New Utrecht, in the county of Kings, in the State of New York, and to establish the same as a post-road.

February 13, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the New Jersey and Staten Island Junction Railroad Company, a corporation existing under the laws of the State of New York, to build and maintain a tunnel under the waters of the bay of New York, from a point in the town of Middletown, in the county of Richmond, in said State, to a point in the town of New Utrecht, in the county of Kings, in said State, for the passage of railroad trains, engines, and cars in

New Jersey and Staten Island Junction Railroad Company may tunnel New York Bay from Middletown to New Utrecht, N. Y.

Railroad tunnel. and through the same, and to lay in and through said tunnel such and so many railway tracks as may be necessary for the use of said company, and such connections or extensions thereof as may be made, and for the use and more perfect connection of any and all railroads that are or shall be constructed to the said points, and that all railway companies desiring to use the said tunnel shall have and be entitled to equal rights and privileges in the passage through the same, and in the use of the tracks and fixtures thereof, and of all the approaches thereto, for a reasonable compensation, to be paid to the owners of said tunnel, under and upon such terms and conditions as shall be agreed to by the owners of said tunnel and such other railway companies: *Provided, however*, That in case such parties can not so agree then, and in such case, such other railway companies shall have the right to so use the tunnel under such terms and conditions as shall be prescribed by the Secretary of War, after hearing the allegations and proof of the respective parties.

Tracks, etc.

Use by other companies.

Terms.

Proviso.

Disagreement.

Security of navigation. SEC. 2. That said tunnel shall be so constructed as not in any manner to intefere with the navigation of ships, steamboats, and other water-craft in the said bay of New York; that the upper surface of the covering arch of the said tunnel shall be placed at a depth below the bed of the said bay sufficient to save and protect the waters of the said bay and the currents and channels thereof from any change or alteration by reason of the construction of the said tunnel or any part thereof; and no obstruction, either of a temporary or permanent character, to the free and unrestricted navigation of the said bay of New York shall be built anywhere within the waters of said bay in connection with the construction of the tunnel or any part thereof.

Depth below bed.

No obstruction in waters.

Lawful structure and post-route. SEC. 3. That any tunnel constructed under this act together with the approaches thereto, and according to its terms and limitations, shall be a lawful structure, and shall be recognized and known as a post-route, upon which no higher charge shall be made for the transportation over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for their transportation over the railroads or public highways leading to said tunnel; and the United States shall have the right of way for postal telegraph purposes through and in said said tunnel, and over the approaches thereto.

Postal telegraph.

Secretary of War to approve plan, location, etc. SEC. 4. That the plan and location of said tunnel, with a detailed map of the bay of New York at, over, and near to the proposed site of the said tunnel, exhibiting the depth of water and the currents and channel thereof, shall be submitted to the Secretary of War for his approval, and until he shall approve the plan and location of said tunnel, it shall not be built, but upon the approval of said plans by the Secretary of War the said company may proceed to the building of the said tunnel in conformity with said approved plan; and no change shall be made in the plan or location of said tunnel during the progress of the work thereon, except the same be first approved by the Secretary of War.

Change of plan, etc.

Structural changes, etc. If the Secretary of War shall at any time deem any change or alterations necessary in the said tunnel, so that the same shall not interfere with or endanger the navigation of ships, steam-boats, and other water-craft, or if he shall deem the disuse of the whole structure necessary for the preservation of the harbor for the purpose of navigation, the alteration so required shall be made at the expense of the parties owning said structure.

Commencement and completion. SEC. 5. That if work shall not be commenced upon said tunnel within three years and completed within ten years after the passage of this act, the rights and privileges hereby granted shall determine and cease.

Amendment, etc. SEC. 6. That the right to alter, amend, or repeal this act is hereby expressly reserved.

Approved, February 13, 1891.

CHAP. 167.—An act authorizing the construction of a railway, street railway, motor, wagon, and pedestrian bridge over the Missouri River near Council Bluffs, Iowa, and Omaha, Nebraska. February 13, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Interstate Bridge and Street Railway Company, a corporation duly authorized and existing under the laws of the State of Nebraska, its successors and assigns, be, and are hereby, authorized to construct and maintain a bridge, and approaches thereto, across the Missouri River between the city of Council Bluffs, in the State of Iowa, and the lands of the East Omaha Land Company, at some point at least one-third of a mile from any other bridge, to be selected consistent with the interests of river navigation. Said bridge shall be constructed to provide for the passage of railway trains, wagons, and vehicles of all kinds, street railway cars, motor cars, animals, foot passengers, and for all road travel for such reasonable rates of toll and under such reasonable rules and regulations as may be prescribed by said corporation, its successors and assigns, and to be approved from time to time by the Secretary of War. And all railroads and street railways reaching the Missouri River near said point shall be permitted the unobstructed use of said bridge, and the approaches thereto, for engines, cars, and trains in the case of railroads, and for electrical or cable equipments and cars in the case of street railways, at reasonable compensation and rate of toll.

Interstate Bridge and Street Railway Company may bridge Missouri River near Council Bluffs, Iowa.

Location.

Railway, wagon, or foot bridge.

Tolls.

Use by other companies.

Terms.

SEC. 2. That said bridge shall be constructed in all respects as a first-class railroad bridge, with ample trackage facilities, and with foundations and superstructure of sufficient strength to admit of the safe passage over the same of railway trains of the maximum weight usually drawn over like railway bridges of the first class by the use of locomotives, and said bridge shall not be built or commenced until the plan and specifications for its construction have been submitted to the Secretary of War for his approval, nor until he shall approve the plan and location of said bridge; and if any change be made in the plan of construction of said bridge at any time such change shall be subject to the approval of the Secretary of War; and any change in the construction, or any alteration of said bridge that may be directed at any time by Congress or the Secretary of War, shall be made at the cost and expense of the owners thereof. That the said bridge shall be constructed without interference with the security and convenience of navigation of said river beyond what is necessary to carry into effect the the rights and privileges hereby granted, and in order to secure that object the said corporation shall submit to the Secretary of War, for his examination and approval, a design of and drawings for said bridge, and a map of the proposed location, giving, for the space of one mile above and one mile below such proposed location, the high and low water lines upon the banks of the river, the direction and strength of the currents at all stages of the water, with soundings accurately showing the bed of the stream and the location of any other bridge or bridges, such maps to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge; and shall furnish such other information as may be required for a full understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the construction of said bridge shall not be commenced.

Construction.

Secretary of War to approve plans, etc.

Change in plan.

Structural changes, etc.

Security of navigation.

Designs, maps, etc.

SEC. 3. That said bridge shall be constructed as a pivot drawbridge, with one draw span affording two clear openings of not less than two hundred feet each, which draw span shall be maintained over the main channel of the river at an accessible and navigable point and with a fixed span or spans each not less than three hundred feet in length in the clear; and the head room under such spans shall not be less than ten feet above the standard high-water grade line established by the Missouri River Commission in eighteen hundred and eighty-nine and now in force; and the piers of said bridge shall be parallel with, and the bridge itself at right angles to, the current of the river: *Provided, also,* That said draw shall be opened promptly by said company, upon reasonable signal, for the passage of boats and rafts, and said company or corporation shall maintain at its own expense, from sunset till sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe: *Provided further,* That the said Interstate Bridge and Street Railway Company shall, at its own expense, build and

Pivot draw.

Openings at draw.

Fixed spans.

Head room.

Piers, etc.

Provisos.

Opening of draw.

Lights, etc.

maintain, under the direction and supervision of the Secretary of War, such wing dams and booms or other works necessary to maintain the channel within the draw span of said bridge, and shall, at their own expense, maintain a depth of water through said draw span not less than that now existing, as shown by the report of the War Department, at the point where said bridge may be located; and if said Interstate Bridge and Street Railway Company shall fail to maintain such channels aforesaid, then the Secretary of War may cause said channel to be opened and maintained at proper depth for navigation through said span at the expense of the owners of said bridge.

Wing dams, etc.

Depth of water at draw.

Failure to maintain channel.

Notification of approval of plans, etc.

SEC. 4. That the Secretary of War is hereby authorized and directed, upon receiving such plan and other information, and upon being satisfied that a bridge so built will conform to the requirements of this act, to notify the company or corporation authorized to build the same that he approves of the same; and upon receiving such notification, the said company or corporation may proceed to erect said bridge, conforming strictly to the approved plan and location, and should any change be made in the plan of the bridge or accessory works during the progress of the work thereon, such change shall be subject likewise to the approval of the Secretary of War.

Lawful structure and post route.

SEC. 5. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rate per mile paid for the transportation over the railroad or public highways leading to the said bridge, and it shall enjoy the rights and privileges of other post roads in the United States; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes.

Use by telegraph, etc., companies.

Postal telegraph.

Use by other railway, etc., companies.

Terms.

SEC. 6. That all railroad and street railway companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railroad trains or cars over the same and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad or street railway companies, or any one of them, desiring such use shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Disagreement.

Determination by Secretary of War.

Amendment, etc.

SEC. 7. That Congress shall have the power at any time to alter, amend, or repeal this act, and the Secretary of War, whenever he shall deem it necessary, may cause the owners of said bridge to remove all material and substantial obstructions to the navigation of said river by the construction of said bridge and its accessory works, or to prevent such obstruction; and the expense of altering said bridge or removing such obstructions shall be paid by the owners of such bridge.

Obstructions to navigation.

Commencement and completion.

SEC. 8. That this act shall be null and void if construction of said bridge shall not be commenced on or before the first day of January, eighteen hundred and ninety-two, and be completed on or before the first day of July, eighteen hundred and ninety-three.

Approved, February 13, 1891.

February 13, 1891.

CHAP. 168.—An act to give consent of Congress to the construction of a bridge over the Duck River in Humphreys County, Tennessee.

The county of Humphreys, Tenn., may bridge Duck River in Humphreys County, Tenn.

Location.

Free wagon and foot bridge.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the consent of Congress is hereby given to the county of Humphreys, in the State of Tennessee, to construct and maintain a bridge and approaches thereto over the Duck River, at or near the present crossing of any public road leading from Waverly to Bakerville, in the said county of Humphreys, Tennessee. Said bridge shall be constructed to provide for the free passage of wagons and vehicles of all kinds, for the transit of animals, and for foot-passengers.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other post-roads in the United States: *Provided*, That the United States may construct a postal telegraph over said bridge without charge therefor.

Lawful structure and post-route.

Proviso. Postal telegraph.

SEC. 3. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said county shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore-lines at high and low water, the direction and strength of the currents at all stages, and the soundings accurately showing the bed of the stream, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject. And until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be built, and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War. And the said bridge shall be at all times so managed and kept as to offer reasonable and proper means for the passage of vessels through or under said bridge; and to secure the safe passage of vessels at night there shall be displayed on said bridge, from sunset to sunrise, such lights or other signals as may be prescribed by the Light-House Board.

Security of navigation.

Maps, designs, etc.

Secretary of War to approve location, etc.

Change of plan.

Passage of vessels.

Lights, etc.

SEC. 4. That the right to alter, amend, or repeal this act is hereby exprsssly reserved, and the right to require any changes in said structure, or its entire removal at the expense of the owners thereof, whenever Congress shall decide that the public interest requires it, is also expressly reserved.

Amendment, etc.

Structural changes, etc.

SEC. 5. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Commencement and completion.

Approved, February 13, 1891.

CHAP. 248.—An act to provide for the selection of a site for a military post at San Diego, California, and for other purposes.

February 21, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized and directed to cause an examination to be made for a suitable site for a military post and harbor defenses at or near the city of San Diego, in the State of California, and to report to Congress a particular description of the land required for such purposes and the amount of money for which the owners of such land will convey the same to the United States for the purposes aforesaid. He shall further report what in his opinion is the value of such land, and if the price asked for the same is reasonable.

San Diego, Cal.

Military post and harbor defenses.

Site.

Examination and report.

Appraisement.

Approved, February 21, 1891.

CHAP. 252.—An act to facilitate the collection of commercial statistics required by section two of the river and harbor appropriation acts of eighteen hundred and sixty-six and eighteen hundred and sixty-seven.

February 21, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That owners, agents, masters, and clerks of vessels arriving at or departing from localities where works of river and harbor improvement are carried on shall furnish, on application of the persons in local charge of the works, a comprehensive statement of vessels, passengers, freight, and tonnage.

Commercial statistics at river and harbor works.

Vol. 14, pp. 73. 421.

Vessel owners, etc., must furnish statement.

SEC. 2. That every person or persons offending against the provi-

Penalty.

sions of this act shall, for each and every offense, be liable to a fine of one hundred dollars, or imprisonment not exceeding two months, to be enforced in any district court in the United States within whose territorial jurisdiction such offense may have been committed.

Enforcement.

Approved, February 21, 1891.

February 24, 1891.

CHAP. 283.—An act making appropriations for fortifications and other works of defense, for the armament thereof, for the procurement of heavy ordnance for trial and service, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sums of money herein provided for be, and the same are hereby, appropriated, out of any moneys in the Treasury not otherwise appropriated, to be available until expended, namely:

Fortifications appropriations.
Available until expended.

PRESERVATION AND REPAIR OF FORTIFICATIONS: For the protection, preservation, and repair of fortifications for which there may be no special appropriation available, eighty thousand dollars.

Preservation and repair.

For preparation of plans for fortifications, five thousand dollars.

Plans.

For protection of the shore at Fort Monroe, Virginia, twenty-seven thousand dollars.

Shore at Fort Monroe, Va.

Artesian well at Fort Monroe, Virginia: For obtaining water for the garrison, six thousand dollars.

Water.

TORPEDOES FOR HARBOR DEFENSE: For the purchase of submarine mines and necessary appliances to operate them for closing the channels leading to our principal seaports, fifty thousand dollars.

Torpedoes.

For needful casemates, and cable galleries, to render it possible to operate submarine mines, fifty thousand dollars.

For construction of a wharf, a keeper's dwelling, and for a water supply for the torpedo station at Yerba Buena Island, California, sixteen thousand dollars.

Torpedo station, Yerba Buena Island, California.

GUN AND MORTAR BATTERIES: For construction of gun and mortar batteries for defense of Boston Harbor, New York Harbor, San Francisco Harbor, Hampton Roads, and Washington, seven hundred and fifty thousand dollars.

Gun and mortar batteries: Boston, New York, San Francisco, Hampton, Washington.

SITES FOR FORTIFICATIONS AND SEACOAST DEFENSES: For the procurement of land, or right pertaining thereto, needed for the site, location, construction, or prosecution of works, for fortifications and coast defenses, five hundred thousand dollars, or so much thereof as may be necessary.

Sites for fortifications and seacoast defenses.

For the following, to be expended under the direct supervision of the Board of Ordnance and Fortification, created by the fortification appropriation act, approved September twenty-second, eighteen hundred and eighty-eight, and in the manner prescribed by said act, namely:

Under supervision of Board. Vol. 25, p. 489.

* * * * * * *

BOARD OF ORDNANCE AND FORTIFICATION: To enable the board to make all needful and proper purchases, experiments, and tests to ascertain, with a view to their utilization by the Government, the most effective guns, small arms, cartridges, projectiles, fuses, explosives, torpedoes, armor-plates, and other implements and engines of war, and to purchase, or cause to be manufactured under authority of the Secretary of War, such guns, carriages, armor-plates, and other war materials and articles as may, in the judgment of the board, be necessary in the proper discharge of the duty devolved upon it by the act approved September twenty-second, eighteen hundred and eighty-eight, one hundred and fifty thousand dollars.

Board of Ordnance and Fortification.
Experimental tests, etc., of guns, explosives, projectiles, armor-plates, etc.

And one additional member shall be added to said Board of Ordnance and Fortification who shall be a civilian and not an ex-officer of the regular Army or Navy, and he shall be nominated by the President, and by and with the advice and consent of the Senate, appointed, and shall be paid a salary of five thousand dollars per annum and actual traveling expenses when traveling on duty: *Provided*, That the Board of Ordnance and Fortification shall make an annual report to Congress through the Secretary of War, on the first Monday in December in each year, showing the general operations of the Board and shall

Appointment of one additional member of Board
Civilian.
Compensation, etc.
Proviso.
Annual Report.

give a detailed statement of all contracts, allotments and expenditures made by the Board; the first of these reports to cover these subject-matters from the beginning of the operations by the Board until the first report which they shall make.

That section two of "An act making appropriations for fortifications and other works of defense, for the armament thereof, for the procurement of heavy ordnance for trial and service, and for other purposes," approved August eighteenth, eighteen hundred and ninety, is hereby modified and enlarged so that the amount authorized to be expended thereunder be increased to four million two hundred and fifty thousand dollars, to be expended on the terms and conditions and for the purposes therein set forth, except that fifty thousand of said sum shall be reserved to cover all expenses other than the powder and projectiles incident to the tests and inspection of the guns, and also that the Secretary of War be authorized to contract thereunder for such less number of guns than one hundred as he may deem for the best interests of the Government.

Laws, 1st sess., 51st Cong., p. 319, modified.

Maximum limit of expenditure enlarged.

Reservation.

Decreased number of heavy guns may be purchased.

That all material purchased under the foregoing provisions of this act shall be of American manufacture, except in cases when, in the judgment of the Secretary of War, it is to the manifest interest of the United States to make purchases in limited quantities abroad, which material shall be admitted free of duty.

American manufacture.

Exception.

Foreign material, duty free.

* * * * * *

Approved, February 24, 1891.

CHAP. 284.—An act making appropriations for the support of the Army for the fiscal year ending June thirtieth, eighteen hundred and ninety-two, and for other purposes.

February 24, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and they are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the support of the Army for the year ending June thirtieth, eighteen hundred and ninety-two:

Army appropriations.

* * * * * * *

MISCELLANEOUS.

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For additional pay to officer in charge of public buildings and grounds, in Washington, District of Columbia, one thousand dollars.

Public buildings, Washington, D. C.

* * * * * * *

ENGINEER DEPARTMENT.

Engineer Department.

Engineer depot at Willets Point, New York: Incidental expenses of the depot, including fuel, lights, chemicals, stationery, hardware, extra duty pay to soldiers necessarily employed for periods of not less than ten days as artificers on work in addition to and not strictly in line of their military duties, such as carpenters, blacksmiths, draughtsmen, printers, lithographers, photographers, engine-drivers, teamsters, wheelwrights, masons, machinists, painters, overseers, laborers, repairs of and for materials to repair public buildings, machinery, and unforeseen expenses, five thousand dollars.

Incidental expenses.

For purchase of materials for the instruction of engineer troops at Willets Point in their special duties of sappers, miners, for land and submarine mines, and pontoneers, torpedo drill and signaling, three thousand five hundred dollars.

For purchase and repairs of instruments to be issued to officers of the Corps of Engineers, and to officers detailed and on duty as acting engineer officers for use on public works and surveys, two thousand dollars.

Library of the Engineer School of Application: Purchase and binding of professional works of recent date treating of military and civil engineering, and kindred scientific subjects, five hundred dollars.

New building, etc. For fireproof building to replace engineer depot store house destroyed by fire May tenth, eighteen hundred and ninety, for storing intrenching tools, bridge equipage, pontoon material, and general stores, sixteen thousand dollars. In all, twenty-seven thousand dollars.

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Approved, February 24, 1891.

February 24, 1891. CHAP. 286.—An act to authorize the construction of a bridge across the Saint Louis River between the States of Wisconsin and Minnesota.

Duluth, Red Wing and Southern Railroad Company and Superior Belt Line and Terminal Railway Company may bridge Saint Louis River between Minn. and Wis.

Location.

Railway, or railway, wagon, and foot bridge.

Toll.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Duluth, Red Wing and Southern Railroad Company, a corporation organized and existing under the laws of the States of Wisconsin and Minnesota, and the Superior Belt Line and Terminal Railway Company, a corporation existing under the laws of Wisconsin, be, and are hereby, authorized to construct and maintain a bridge, and approaches thereto, over the Saint Louis River between the States of Minnesota and Wisconsin at the most feasible point in the State of Wisconsin, in section ten or eleven, township forty-eight north, of range fifteen west, to a point opposite in the State of Minnesota. Said bridge shall be constructed to provide for the passage of railway trains, and, at the option of the said corporation by which it may be built, may be used for the passage of wagons and vehicles of all kinds, and for the transit of animals, and for foot passengers; and all for such reasonable rates of toll in all cases as may be approved from time to time by the Secretary of War.

Security of navigation.

SEC. 2. That any bridge built under this act shall be built and constructed without material interference with the security and convenience of navigation of said river beyond what is necessary to carry into effect the rights and privileges hereby granted, and in order to secure compliance with these conditions the corporation, previous to commencing the construction of the bridge, or of the accessory works designed to secure the best practical channel way for navigation, and confine the flow of water to a permanent channel at said point, shall

Secretary of War to approve plans, etc.

submit to the Secretary of War a plan of the bridge and accessory works provided for in this act, together with a detailed map of the river at the proposed site of the bridge, and for a distance of a mile above and below the site, with all such other information touching said bridge and river and accessory works as may be deemed requisite by the Secretary of War to determine whether said bridge, when built, will conform to the prescribed conditions of this act.

Pivot draw.

SEC. 3. That the bridge built under this act shall be constructed as a pivot drawbridge with a draw over the main channel of the river at

Span.

an accessible and best navigable point, and with a span of not less than one hundred and ten feet in length in the clear on each side of the central or pivot pier of the draw, measured at right angles to the axis of

Provisos.

Opening of draw.

the channel: *Provided*, That the said draw shall be opened promptly upon reasonable signal for the passage of boats, vessels, and other water craft: *Provided, however*, That no bridge shall be built under the provisions of this act, except there also be built, at the time of the erec-

Sheer booms, etc.

tion of the piers, proper sheer booms or other protections to safely guide boats, vessels, rafts, and other water craft through said spans, and at the expense of the company or corporation erecting said bridge; and said company or corporation shall maintain, at its own expense,

Lights, etc.

from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

SEC. 4. That the Secretary of War is hereby authorized and directed, upon receiving any such plan and map and other information, and upon being satisfied that the bridge built on such plan and with such accessory works and at such locality will conform to the prescribed condi-

Notification of approval.

tions of this act, to notify the company that he approves the same; and upon receiving such notification the said company may proceed to the erection of said bridge, conforming strictly to the approved plan and location; but until the Secretary of War approve the plan and

Limitation.

location of said bridge and accessory works and notify the company of the same, the bridge shall not be built or commenced; and should any

change be made in the plan of the bridge or accessory works during the progress of the work thereon, such change shall be subject likewise to the approval of the Secretary of War, not, however, to be in anywise inconsistent with the provisions or conditions of this act: *Provided*, That if at any time, in the opinion of the Secretary of War, a raft span in said bridge shall be necessary for the interests of commerce the said company shall put in a span of such width, not less than one hundred and fifty feet, as the Secretary of War may direct.

Change of plan.

Proviso.

Raft span.

SEC. 5. That any bridge and accessory works when built and constructed under this act and according to the terms and limitations thereof shall be a lawful structure; and said bridge shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and munitions of war of the United States than the rate per mile paid for the transportation over the railroads or public highways leading to said bridge; and said bridge shall enjoy the rights and privileges of the other post routes in the United States; and Congress reserves the right at any time to regulate by proper legislation the charges for freight and passengers over said bridge; and the United States shall have the right of way for postal telegraph and telephone lines free of charge across said bridge.

Lawful structure and post route.

Freight, etc., charges.

Postal telegraph.

SEC. 6. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railroad trains or cars over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use, and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use shall fail to agree on the sum or sums to be paid, and upon the rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon the hearing of the allegations and proofs of the parties.

Use by other railroad companies.

Terms.

Disagreements.

Secretary of War to decide.

SEC. 7. That it shall be the duty of the Secretary of War to require the company or persons owning said bridge to cause such aids to the passage of said bridge authorized by the provisions of this act to be constructed, placed, and maintained at their own expense and cost, in the form of booms, dykes, piers, or other suitable and proper structures for the confining of the flow of water to a permanent channel and for the guiding of steamboats, rafts, and other water craft safely through the draw and raft span, as shall be specified in his order in that behalf, and on the failure of the company or persons aforesaid to make and establish such additional structures within a reasonable time, the said Secretary shall proceed to cause the same to be built or made at the expense of the United States, and shall refer the matter without delay to the Attorney-General of the United States, whose duty it shall be to institute in the name of the United States proceedings in any circuit court of the United States for the circuit in which said bridge or any part thereof is located for the recovery of the cost thereof, and all moneys accruing from such proceedings shall be covered into the Treasury of the United States.

Aids to navigation.

Failure to construct.

United States to build.

Proceedings to recover costs.

Disposal of accruing moneys.

SEC. 8. That the right to alter, amend, or repeal this act is hereby expressly reserved; and the right to require any changes in said structure, at the expense of the owners thereof, whenever Congress shall decide that the public interests require it, is also expressly reserved.

Amendment, etc.

Structural changes.

SEC. 9. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof: *And provided*, That if either of the corporations named in this act shall for the period of eight months from the date hereof neglect, refuse, or fail to begin operations hereunder, then the other party shall succeed to all the rights and privileges herein granted, and may proceed under the terms hereof to construct and equip said bridge.

Commencement and completion.

Proviso.

Neglect of either corporation to begin.

Succession to rights.

SEC. 10. That this act shall take effect and be in force from and after its passage.

Operation.

Approved, February 24, 1891.

February 24, 1891. **CHAP. 291.**—An act to amend an act entitled "An act for the construction of a bridge at South Saint Paul, Minnesota."

South Saint Paul Belt Railroad Company's bridge over Mississippi River at South Saint Paul, Minn.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the act entitled "An act for the construction of a railroad and wagon bridge across the Mississippi River at South Saint Paul, Minnesota," approved April twenty-sixth, eighteen hundred and ninety, be, and hereby is, amended as follows:

Laws, 1st sess. 51st Cong., p. 69, amended.

First, by striking out section one of said bill and substituting in lieu thereof the following, to wit:

"That the South Saint Paul Belt Railroad Company, its successors and assigns, be, and they are hereby, authorized to construct and maintain, at a point suitable to the interest of navigation, a railroad bridge or a combined railroad, wagon, and foot passenger bridge across the

Location.

Mississippi river from a suitable point on its west bank, at or near the city of South Saint Paul, in the State of Minnesota, and within the limits of section thirty-five, township twenty-eight, range twenty-two west, to a corresponding point on its east bank, and to lay on or over said bridge a railroad track or tracks for the more perfect connection of any railroad or railroads that are or shall be constructed to said river, on either or both sides thereof at or opposite said places, under the limitations and conditions hereinafter provided; that said bridge shall not interfere with the free navigation of said river beyond what

Free navigation.

is necessary in order to carry into effect the rights and privileges hereby granted, and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, or damage re-

Litigation.

sulting from the same, the cause may be tried before the circuit court of the United States in and for any district in which any portion of said bridge or obstruction touches; said bridge may, at the option of

Railway, or railway, wagon, and foot bridge.

the company building the same, be constructed to provide for the passage of railroad trains alone, or for the passage of railroad trains and for the safe passage of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers, all for such reasonable rates of

Tolls.

toll as may be fixed from time to time by the Secretary of War."

Laws, 1st sess. 51st Cong., p. 71, amended.

Second, by striking out section seven of said bill and substituting in lieu thereof the following, to wit:

Commencement and completion extended.

"SEC. 7. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of the approval of these amendments.

Approved, February 24, 1891.

February 28, 1891. **CHAP. 382.**—An act to incorporate the Washington and Arlington Railway Company of the District of Columbia.

Washington and Arlington Railway Company incorporated; granted right of way through Fort Myer reservation and may bridge Potomac River at Washington, D. C.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That W. H. Randle, D. C. Forney, J. S. Lawrence, Beriah Wilkins, C. G. Lee, James L. Barbour, and their associates and assigns, be, and they are hereby, created a body corporate under the name of the Washington and Arlington Railway Company of the District of Columbia, with authority to construct and lay down a single or double track railway, with necessary switches, turn-outs, and other mechanical devices for operating the same, by

Incorporators.

Tracks, etc.

Power.

horse, cable, compressed air or other power to be approved by the Commissioners of the District of Columbia, or electric power, for carrying passengers, parcels, milk, and truck, by the following route, namely:

Location.

Beginning on Sixth street near B street northwest; along B street and Virginia avenue northwest to Twenty-sixth street; along Twenty-sixth street to M street; along M street and Canal road to a point on the Potomac River at or near the point known as "The Three Sisters," where the said company is hereby authorized to construct and

May bridge Potomac River at "The Three Sisters."

maintain a bridge across the Potomac River on such plans as the Secretary of War may approve; and from thence by, on, and over such lines as may be selected by the said company, with the approval of the Secretary of War, to the northwest entrance of the Arlington Cemetery, and thence through the Arlington estate outside of the cemetery grounds to the south or west line thereof, in the State of Virginia:

Provided, That said road shall cross the Chesapeake and Ohio Canal on a bridge that shall be so constructed as not to interfere with the use of the bed or tow-path of the canal as a waterway, or as a railway, and in a manner satisfactory to the Secretary of War: *Provided*, That said company shall not operate any part of its line by electric power with overhead wires within the city limits: *Provided*, That should any part of the track herein authorized occupy the same street or avenue with portions of any other duly incorporated street railway in the District of Columbia but one set of tracks shall be used; and the relative conditions of use and of chartered rights may be adjusted upon terms to be mutually agreed upon between the companies, or, in the case of disagreement, by the supreme court of the District of Columbia on petition filed therein by either party, and on such reasonable notice to the other party as the court may order: *And provided*, That no work shall be done on said road in the District of Columbia, until the plans and specifications for the proposed bridge on the Potomac River at or near "The Three Sisters" shall have been approved by the Secretary of War, and the construction of said bridge actually commenced: *And provided*, That so much of said line as may lie within the State of Virginia shall first receive the approval of the proper authorities of said State. And said company is hereby authorized to run its said railway through the United States reservation known as Fort Myer and such other land of the United States in the State of Virginia, excepting the Arlington Cemetery Grounds, as may be necessary to construct the railway between the points named in this bill: only if the Secretary of War shall deem the same promotive of the public interest and always subject to such conditions and regulations as the Secretary of War may from time to time impose.

Provisos.
Chesapeake and Ohio Canal to be bridged.
Overhead wires in city limits.
Coinciding tracks.
Terms for use of other lines.
Litigation.
Secretary of War to approve bridge plans, etc., prior to commencement of road in District.
Consent of Virginia.
Right of way through Fort Myer reservation, etc.
Arlington Cemetery Grounds excepted.
Limitation.
Regulations, etc.

SEC. 2. That the railway hereby authorized and lying in the District of Columbia and on the bridge shall be constructed by said company of good materials, and in a substantial manner, with grooved rails of the best pattern, and of a suitable gauge,—all to be approved by the Commissioners of the District of Columbia and the Secretary of War jointly. The tracks of said railway, so far as the same shall lie within the District of Columbia, and the space between the same and for two feet adjacent to the outer rails thereof, shall be at all times kept by said company well paved and in good order to the satisfaction of the Commissioners of the District of Columbia; and it shall be lawful for said company to make all needful and convenient trenches and excavations in any streets or spaces where its railway may be constructed, and to place in such trenches and excavations all the needful and convenient devices and machinery for operating said railway in the manner and by the means aforesaid, subject to the approval of the Commissioners of the District of Columbia, and subject to the other provisions of this act; and, also, it shall be lawful for said company to erect and maintain, at such convenient and suitable points along its line not in any avenue, street, alley, or other public place as may be deemed advisable by said company or its board of directors, and subject to the approval and regulations from time to time made by the Commissioners of the District of Columbia over the place or places where the same may be located, an engine house or houses, boiler house or houses, and other buildings necessary for the successful operation of said road.

Construction of railway on bridge, etc.
Joint approval.
Tracks, etc., in District.
Paving.
Excavations for machinery, etc.
Operative buildings, etc.

SEC. 3. That the said company may receive a rate of fare not exceeding five cents for each passenger for one continous ride over the route aforesaid or any part thereof, between the termini of said railroad, and shall sell tickets at the rate of six for twenty-five cents. Said company shall, on or before the fifteenth day of January of each year, report to Congress the names of all the stockholders thereof and the amount of stock held by each, together with a detailed statement of the receipts and expenditures from different sources and on whatever account for the preceding year ending December thirty-first, which report shall be verified by the affidavit of the president and secretary of said company; and said company shall pay to the District of Columbia, in lieu of taxes on personal property for the next ensuing fiscal year, four per centum of its gross earnings upon traffic for the preceding year, which amount shall be paid to the collector of taxes at the times and in the manner that other taxes are or may be payable and subject to the same penalty in case of arrears; and the franchise and property of said company, both real and personal, to a sufficient amount may be seized and sold in satisfaction thereof in the same

Fare.
Tickets.
Annual report to Congress.
Payment to District in lieu of taxes on personalty.
Tax-arrearage.
Penalty, etc.

manner as is or may be provided by law for the sale of other property for taxes, and said per centum of its gross earnings shall be in lieu of any and all other assessments upon its personal property in the District of Columbia, used solely and exclusively in the operation and management of said railway; but its real estate in said District shall be taxed as other real estate therein: *Provided*, That its tracks shall not be considered real estate for the purpose of taxation.

Tax on realty. *Proviso.* Tracks exempted.

Capital stock.

SEC. 4. That the capital stock of said company shall be fifty thousand dollars, and may be increased to three hundred thousand dollars by order of a majority of the stockholders at a general meeting, in shares of one hundred dollars each. Said company shall require the subscribers to its capital stock to pay in cash to the treasurer, appointed by the corporators hereinbefore named, the amounts severally subscribed by them as follows, to wit: Ten per centum at the time of subscribing and the balance at such times and in such amounts as the board of directors of said company may require; and no subscription shall be deemed valid unless ten per centum thereof shall be paid at the time of subscription, as hereinbefore provided; and if any stockholder shall refuse or neglect to pay any installment or installments as aforesaid, or as required by the resolution of the board of directors, said board may sell at public auction to the highest bidder so many shares of the stock of such defaulting stockholder as shall be necessary to pay said installments, under such general regulations as may be adopted by the by-laws of said company, and for the purposes of such sale the highest bidder shall be deemed and taken to be the person who shall offer to purchase the least number of shares for the assessments due; but no stock shall be sold at such sale for less than the total assessments due and payable at the time thereof; or said company may sue and collect from any delinquent subscriber, in any court of competent jurisdiction, the amount of the assessments at any time due and payable in accordance herewith, and bonds may be issued in amount not exceeding fifty per cent. of the stock subscribed and paid for: *Provided*, That the entire issue of stock and bonds shall not exceed the actual cost of constructing and equipping the road, including the bridge; *and provided, also*, that the total amount of bonds issued shall not exceed double the amount of the paid-up stock; and every certificate of stock issued shall show the amount paid on same, to be secured by mortgage or deed of trust upon the property of the company.

Terms of subscription.

Delinquent stockholders.

Provisos. Maximum stock and bond issue. Limit of bond issue. *Post*, 513.

Character of cars.

SEC. 5. That said company shall place first-class cars on its said railway, with all modern improvements, for the convenience and comfort of passengers, and shall run cars thereon as often as the public convenience may require, and according to a schedule to be made from time to time by said company and approved by the Commissioners of the District of Columbia, but no steam cars, locomotives or passenger or other cars for steam railways shall ever be run on the tracks of said railway in the District of Columbia. Said company may buy land on which to construct passenger-rooms, ticket-offices, workshops, depots, and buildings as may be necessary, and as the business of said railway and the convenience of the public may require, at such points along its line as may be approved by the Commissioners of the District of Columbia, as to so much of its railway as lies within the said District, and the Secretary of War as to the remainder of said railway. No person shall be prohibited from riding on the cars of said company or ejected therefrom by the company's employees for any other cause than being drunk, disorderly, or contagiously diseased, or for the use of profane or indecent language, or for refusing to pay the legal fare exacted, or to comply with the lawful general regulations of said company.

Time schedule.

Steam cars, etc., in District, prohibited.

Purchase of land for buildings.

Ejectment, etc., of passengers.

Opening of subscription books.

SEC. 6. That within thirty days after the approval of this act the corporators above named, or a majority of them, or if any refuse or neglect to act, then a majority of the remainder, shall cause books of subscription to the capital stock of said company to be opened, and kept open, in some convenient and accessible place in the District of Columbia from nine o'clock in the forenoon until five o'clock in the afternoon for a period to be fixed by said corporators, not less than two days (unless the whole stock shall be sooner subscribed for), the said corporators shall give notice, by advertisement in two or more of the daily papers published in the city of Washington, District of Columbia, of the time, manner, and the place where said books shall be opened, and subscribers upon said books to the capital stock of said company shall be held to be stockholders therein: *Provided, however*, That every subscriber shall pay at the time of subscription ten per

Provisos. Payments.

centum of the amount by him subscribed to the treasurer appointed by the corporators aforesaid, or his subscription shall be null and void: *And provided further*, That nothing shall be received in payment of the ten per centum aforesaid except lawful money of the United States or certified checks of any established national bank. And when the books of subscription to the capital stock of said company shall be closed the corporators aforesaid, or a majority of them, and in case any of them refuse or neglect to act, a majority of the remainder, shall, within twenty days thereafter, call the first meeting of the stockholders of said company to meet ten days thereafter for the choice of directors, of which meeting notice shall be given by advertisement three times in two public newspapers published daily in the city of Washington aforesaid, and by written personal notice to be mailed to the address of each stockholder by the treasurer aforesaid; and in any meeting of stockholders each share shall entitle the holder to one vote, which may be given either in person or by proxy.

First meeting of stockholders.

Voting.

SEC. 7. That the government and direction of the affairs of said company shall be vested in a board of directors, not less than five nor more than nine in number, who shall be stockholders of record and who shall hold office for one year, and until their successors are duly elected and qualified, and the said directors (a majority of whom shall be a quorum) shall elect one of their number to be president of said company, and shall also elect a vice-president, secretary, and treasurer, the last named of whom shall give a bond, with surety, to said company in such sum as said directors may require, for the faithful discharge of his trust. In case of vacancy in the board of directors by death, resignation, or otherwise of any director, the vacancy occasioned thereby shall be filled by the remaining directors, or in such other manner as the by-laws of said company may prescribe. The directors of said company shall have power to make, prescribe, amend, and alter such by-laws, rules, and regulations as they shall deem needful and proper touching the management of said company, and the disposition and management of its stock, property, estate, and effects.

Board of Directors.

Officers.

Filling vacancies.

By-laws, etc.

SEC. 8. That the principal office of said company shall always be situated in the District of Columbia, and the books and papers relating to the business of said company shall be kept thereat, open at all times to the inspection of the stockholders. The meetings of the stockholders, and directors of said company shall be held at said office, and there shall be an annual meeting of the stockholders for choice of directors to be held at such time, under such conditions, and upon such notice as the said company shall by its by-laws prescribe, and said directors shall hold such meetings as may by said by-laws be prescribed, and shall annually make a report, in writing, of their doings to the stockholders and to the Commissioners of the District of Columbia. The book in which transfers of stock shall be recorded shall be closed for the purpose of such transfer thirty days before the annual election as respects said election, and for the purpose of paying dividends at such lawful and reasonable times before the payment thereof as the by-laws of said company may prescribe.

Principal office.

Annual meeting, etc.

Annual report to stockholders and Commissioners.

SEC. 9. That said company shall commence the construction of its said railway within twelve months from the approval of this act, and said railway shall be built its entire distance, with switches and turnouts, and with cars running thereon for the accommodation of passengers within three years from the date of such approval; otherwise this act shall be null and void.

Commencement and completion of railway.

SEC. 10. That the tracks of said company on the bridge and the approaches to said bridge may be freely used for the passage of cars with motive power of the kind described by this act belonging to any individual or corporation legally authorized thereto, upon making just compensation for such use, and in case any dispute shall arise concerning such compensation or manner of use any party in interest may apply to the Supreme Court of the District of Columbia, which court is hereby empowered to fix the amount to be paid for such use and the mode in which such use may be enjoyed.

Use by other companies of bridge tracks, etc.

Terms.

Litigation.

SEC. 11. That if the corporation can not agree with the owner for the purchase, use, or occupation of land, gravel, earth, timber, or other material required for the construction, enlargement, or repair of any of its works, or if the owner be a married woman, infant, non compos mentis, or out of the District, the said corporation may apply to the

Construction material, etc.

Acquisition of land, etc.

supreme court of the District of Columbia, at any general or special term thereof, and said court after reasonable public notice and hearing shall proceed with the condemnation of such land or property for the use aforesaid.

Condemnation proceedings.

Jury.

SEC. 12. That for the purpose of ascertaining the value of any land or property so condemned the said court may direct the marshal and the marshal shall accordingly summon eighteen disinterested men, not related to either party; and if any of them refuse to attend he may then summon or call others immediately to make up the number of eighteen. Each party shall have the right, in person or by attorney or agent, if present at the time, to strike off three, and the marshal shall strike off such as shall not be so stricken off by the parties, until the number shall be reduced to twelve, who shall be a jury.

Oath, etc.

Inquisition and report.

Return.

SEC. 13. That the marshal shall then administer an oath or affirmation to every person of the jury that he will impartially and to the best of his skill and judgment value the land or other property required by the corporation, and also, if the same be land required for the construction of the said railroad or work, the damage which the owner will sustain, if any, by the taking of the land for such use. The jury shall accordingly inquire of such value and damage, and make report thereof in writing, to be signed by them all, and setting forth in case of land the boundaries of the land and the estate, interest, or use to be taken by the corporation. Such inquisition and report shall be returned by the marshal to the clerk of the circuit court of the District of Columbia.

Confirmation to be recorded.

May be set aside and new inquisition ordered

Payment, etc.

SEC. 14. That such inquisition and report shall be confirmed by such court unless good cause be shown to the contrary, and when confirmed shall be recorded by the clerk of said court; but for cause the court may set it aside and order another inquisition, or more than one from time to time, to be conducted in like manner as the first and with like effect, until an inquisition and report shall be confirmed by the court. Upon such confirmation of the first or any subsequent inquisition and report and upon payment or tender of the amount fixed in the inquisition to be paid by the corporation, either to the owner or in court, as the court shall order, the said corporation shall be entitled to the property according to the nature of such condemnation and appropriation for the uses mentioned in this act.

Protection, etc., of water-pipes etc.

Necessary changes in street grades, etc., to be made by order of Secretary of War, at expense of company, etc.

Other changes not lawful.

SEC. 15. That said railway shall be constructed in such a manner as not to injure or endanger any of the pipes, fixtures, or apparatus of the water works supplying the District of Columbia, or any part thereof, and the operations of said company shall always be subject to the control and direction, in this respect, of the Secretary of War, and subject to the right of the Secretary of War, or other lawful public authority, to interrupt the construction or use of said railway whenever necessary for the protection or repair of such water works, or in respect of any increase thereof or additions thereto. If in the course of construction of said railway, or at any time thereafter, it shall be deemed by the Secretary of War necessary for the better protection of such water pipes, fixtures, or apparatus, or for other water pipes, fixtures or apparatus that may be laid or applied, to raise or otherwise fix or adjust any avenue, street, road, alley or public place containing or to contain such pipes, or to otherwise adjust the same so as to produce absolute security for all such pipes and apparatus existing or to be laid or arranged at any point or points on or contiguous to the line of said railway, such changes in grade and otherwise, or works, as shall be deemed necessary by the Secretary of War shall be made, done and performed by and at the expense of said railway company, and its successors and assigns, to the satisfaction of the Secretary of War; and the remainder of width of any avenue, street, alley, road, or other public place, at all such points or places, shall be raised, adjusted, repaved and put in condition, safe for all such pipes and apparatus, and in a manner satisfactory to the Secretary of War, and in conformity to any order of the Secretary of War in the matter, and at the expense of said company, and its successors and assigns. Any structure, work in or change in the condition of any such avenue, street, road, alley or public place, not made in conformity with the provisions in this act contained, shall be unlawful.

Amendment, etc.

SEC. 16. That Congress hereby reserves to itself the right at any and all times to alter, amend, or repeal this act.

Approved, February 28, 1891.

CHAP. 492.—An act to authorize the building of a railroad bridge at Little Rock, Arkansas. March 2, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the Little Rock Bridge and Terminal Railway Company, a corporation organized under the laws of the State of Arkansas, to construct and maintain a bridge and approaches thereto over the Arkansas River, at a point on said river at or near the city of Little Rock, in the State of Arkansas, and to lay on or over said bridge a railroad track or tracks for the more perfect connection of any railroad or railroads that are or shall hereafter be constructed to the said river, on either or both sides thereof, at or opposite said point, under the limitations and conditions hereinafter provided; said bridge shall be constructed to provide for the passage of railway trains, and, at the option of the owners or builders thereof, may be used for the passage of wagons or vehicles of all kinds, for the transit of animals of all kinds, and for foot passengers, for such reasonable rates of toll as may be approved from time to time by the Secretary of War.

Little Rock Bridge and Terminal Railway Company may bridge Arkansas River at Little Rock, Ark.

Railroad tracks.

Railway, or railway, wagon, and foot bridge.

SEC. 2. That any bridge built under this act and subject to its limitations, shall be a lawful structure, and shall be recognized and known as a post route, upon which no higher charge shall be made for the transmission over the same of the mails, troops, and munitions of war, or other property of the United States, than the rate per mile charged for the transportation of the same over the railroads or public highways leading to the said bridge, and it shall enjoy the rights and privileges of other post roads in the United States. Equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes.

Lawful structure and post route.

Use by telegraph, etc., companies.

Postal telegraph.

SEC. 3. That the said bridge shall be constructed with a draw or pivot span, which shall be over the main channel of the river at an accessible navigable point, and the openings on each side of the pivot pier shall not be less than one hundred and sixty feet in the clear, and as nearly as practicable both of said openings shall be accessible at all stages of water; that the spans shall be not less than ten feet above extreme high-water mark, as understood at the point of location, to the lowest point of the superstructure of said bridge; that the piers and draw rests of said bridge shall be built parallel with the current at that stage of the river which is most important for navigation, and the bridge itself at right angles thereto; and that no riprap or other outside protection for imperfect foundations shall be permitted to approach nearer than four feet to the surface of the water at its extreme low stage, or otherwise to encroach upon the channel ways provided for in this act: *Provided,* That said draw shall be opened by the company or persons owning or controlling said bridge upon reasonable signal for the passage of boats or rafts, and there shall be maintained, at the expense of the owners thereof, from sunset till sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

Draw or pivot bridge.

Pivot openings.

Spans.

Piers and draw rests.

Encroachment upon channel ways.

Proviso.

Opening of draw.

Lights, etc.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of trains over the same upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any of them, desiring such use shall fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Use by other companies.

Terms.

Disagreement.

Determination by Secretary of War.

SEC. 5. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation as the Secretary of War shall prescribe, and to secure that object the owner or owners thereof shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the high and low water lines upon the banks of the river, the direction and strength of the current at all stages of the water with the soundings, accurately showing the bed of the stream, and the location of any other bridge or bridges, such map to be sufficiently in detail to enable

Security of navigation.

Secretary of War to approve plans, etc.

the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until such plan and location of the bridge are approved by the Secretary of War, the bridge shall not be commenced or built, and should any change be made in the plan of said bridge during the progress of construction, or after completion, such change shall be subject to the approval of the Secretary of War.

Change in plan.

Amendment, etc.

Structural changes.

SEC. 6. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said structure, or its entire removal at the expense of the owners thereof whenever Congress or the Secretary of War shall decide that the public interest requires it, is also expressly reserved.

Commencement and completion.

SEC. 7. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Approved, March 2, 1891.

March 2, 1891.

CHAP. 501.—An act to authorize the Rapides Bridge Company, limited, to construct and maintain a bridge across Red River at or near Alexandria, Louisiana.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Rapides Bridge Company, limited, a corporation created and existing under and by virtue of the laws of the State of Louisiana, be, and is hereby, authorized to construct and maintain a highway and railway bridge across the Red River at or near the town of Alexandria, the said bridge to be so constructed as not to interfere with the navigation of said river, and to be provided with a suitable draw: *Provided*, That any bridge constructed under this act and according to its limitations shall be a lawful structure, and shall be known and recognized as a post route, and the same is hereby declared to be a post route, and the United States shall have the right of way for a postal telegraph across said bridge.

Rapides Bridge Company may bridge Red River, at Alexandria, La.

Proviso.

Lawful structure and post route.

Secretary of War to approve plans, etc.

SEC. 2. That the bridge authorized to be constructed under this act shall be located and built under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the proposed bridge, and a map of the location, giving, for the space of two miles above and two miles below the proposed location, the high and low water lines upon the banks of the river, the direction and strength of the currents, at all stages of the water, with the soundings, accurately showing the bed of the stream, and the location of any other bridge or bridges, such maps to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War no work upon the bridge shall be commenced; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to the approval of the Secretary of War.

Changes.

Amendment, etc.

SEC. 3. That Congress reserves the right to alter, amend, or repeal this act at any time; and that if at any time navigation of the said river shall in any manner be obstructed or impaired by the said bridge, the Secretary of War shall have authority, and it shall be his duty, to require the said bridge company to alter and change the said bridge at its own expense, in such manner as may be proper to secure free and complete navigation without impediment; and if upon reasonable notice to said bridge company to make such change or improvements the said company fails to do so, the Secretary of War shall have authority to make the same at the expense of said company, and all the rights conferred by this act shall be forfeited; and Congress shall have power to do any and all things necessary to secure the free navigation of the river.

Alterations, etc.

SEC. 4. That said company shall be permitted to charge and take such rates of toll for crossing said bridge as may be reasonable, subject to the approval of the Secretary of War.

Toll.

SEC. 5. That the draw provided for the bridge herein authorized to be constructed shall be opened promptly upon reasonable signal for the passing of boats; and said company or corporation shall maintain, at its own expense, from sunset till sunrise, such lights or other signals on said bridge as the Light House Board shall prescribe.

Draw.

Lights, etc.

SEC. 6. That all telephone and telegraph companies shall be granted equal rights and privileges in the construction and operation of their lines across said bridge; and if actual construction of the bridge herein authorized shall not be commenced within one year from the passage of this act, and be completed within three years from the same date, the rights and privileges hereby granted shall cease and be determined.

Use by telephone and telegraph companies.

Commencement and completion.

SEC. 7. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over the approaches thereto, upon payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them, desiring such use, shall fail, to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties.

Use by railroad companies.

Terms.

SEC. 8. That the said company may associate or join with themselves, in the construction, maintenance, and operation of said bridge, the Kansas City, Watkins and Gulf Railway Company, or any other railway company duly incorporated under the laws of the State of Louisiana.

Joining with other companies authorized.

Approved, March 2, 1891.

CHAP. 520.—An act granting the right of way to the Metropolitan Southern Railroad Company through the property of the United States in Montgomery County, Maryland. March 3, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Metropolitan Southern Railroad Company is hereby authorized to construct its road across the grounds of the United States forming a part of the grounds of the receiving reservoir, in Montgomery County, in the State of Maryland, north of the northeast boundary line of the District of Columbia, and for that purpose said company is hereby granted a width of sixty feet, at grade, and such additional width as it may require for slopes of cuttings and embankments, across said grounds for its right of way through the grounds aforesaid: *Provided*, That the location and plans of said road through said grounds shall be approved by the Secretary of War before the commencement of any work on said grounds, and the work of construction and the operating of said road shall be subject to such regulations as he may prescribe; and the damages for the use and occupation of the right of way herein granted shall be fixed by a board of three Army officers appointed by the Secretary of War, and the payment of said damages so fixed shall be a condition precedent to the exercise of the rights by this act granted, which are to terminate at the pleasure of the Secretary of War, in case of persistent neglect by said company, or by its successors, to comply with the regulations aforesaid.

Metropolitan Southern Railroad Company granted right of way through grounds of receiving reservoir, Montgomery County, Md.

Width.

Proviso.

Approval by Secretary of War.

Damages.

To be paid before right exercised.

Termination.

Approved, March 3, 1891.

CHAP. 522.—An act giving the consent of the United States to the erection of a bridge across Portage Lake, Houghton County, Michigan, between the villages of Houghton and Hancock. March 3, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the consent of the United States is hereby given to the county of Houghton, within the State of Michigan, the same being a body corporate existing under and by virtue of the constitution and laws of said State, to erect or cause to be erected, and maintain the same, a free bridge, with one or more roadways, footways, and draws, over and across Portage Lake, in said

Houghton County, Mich., may bridge Portage Lake between Houghton and Hancock.

Free bridge.

county of Houghton, between the villages of Houghton and Hancock: *Provided,* That said bridge shall be so constructed and built by draw, span, or otherwise, as not to obstruct, impair, or injuriously modify the navigation of said Portage Lake; and in order to secure a compliance with these conditions said county of Houghton, previous to commencing the construction of said bridge, shall submit to the Secretary of War for his examination and approval, a design and drawings of the bridge and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the lake, the shore lines at high and low water, the direction and strength of the current, and the soundings accurately showing the bed of the lake, and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and should any change be made in the plan of said bridge during the progress of construction or after completion, such change shall be subject to the approval of the Secretary of War: *Provided also,* That if the bridge herein authorized be constructed as a draw-bridge, said draw shall be opened promptly upon reasonable signal for the passage of boats, and whatever kind of bridge is built the said County of Houghton shall maintain at its own expense from sunset to sunrise such lights or other signals on said bridge as the Light-House Board shall prescribe.

Provisos.

Unobstructed navigation.

Secretary of War to approve plans, etc.

Draw.

Lights, etc.

Notification of approval.

SEC. 2. That the Secretary of War is hereby authorized and directed upon receiving said plan and map and other information, and upon being satisfied that a bridge built upon such plan and at said locality will conform to the prescribed conditions of this act, not to obstruct, impair, or injuriously modify the navigation of Portage Lake, to notify the said county of Houghton, through the chairman or clerk of the board of supervisors of said county, that he approves the same; and upon receiving such notification the said county of Houghton may proceed to the erection of said bridge, conforming strictly to the approved plan and location. But until the Secretary of War approve the plan and location of said bridge and notify the said county of Houghton of the same, the said bridge shall not be built or commenced.

Construction to await approval.

Rules and regulations.

SEC. 3. That the aforesaid county of Houghton is hereby authorized and empowered, so far as Congress has the power to grant the same, to make such rules and regulations for the care of said bridge as its board of supervisors may deem necessary.

Lawful structure and post-route.

Use by telegraph and telephone companies.

Postal telegraph.

SEC. 4. That any bridge built under this act and subject to its limitations shall be a lawful structure and shall be recognized and known as a post-route, and it shall enjoy the rights and privileges of other post-roads in the United States; and equal privileges in the use of said bridge shall be granted to all telegraph and telephone companies; and the United States shall have the right of way across said bridge, and approaches, for postal telegraph purposes.

Amendment, etc.

SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in said structure, or its entire removal, at the expense of the owners thereof, whenever the Secretary of War shall decide that the public interests require it, is also expressly reserved.

Commencement and completion.

SEC. 6. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within two years from the date hereof.

Approved, March 3, 1891.

March 3, 1891.

CHAP. 523.—An act authorizing the Lexington Pontoon Bridge Company to construct and maintain a pontoon bridge across the Missouri River, at the city of Lexington, in the State of Missouri.

Lexington Pontoon Bridge Company may bridge Missouri River at Lexington, Mo.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the Lexington Pontoon Bridge Company, a corporation having authority from the State of Missouri, its successors and assigns, to build, construct, and maintain a pontoon wagon and foot bridge across the Missouri River at some convenient point in or near the corporate limits of

the city of Lexington, in Lafayette County, in said State, and extending to the county of Ray, opposite thereto.

SEC. 2. That said bridge shall be constructed with one suitable pontoon-draw of not less than five hundred feet in width, located over the main channel of said river, which said draw shall be opened promptly upon reasonable signal to allow the passage of boats: *Provided*, That said bridge shall not interfere with the place for landing of steamboats at Lexington.

Draw.

Proviso. Steamboat landing.

SEC. 3. That said bridge shall be built and located under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval, a design and drawings of the bridge, and a map of the location showing, the entire river-front of the city of Lexington, with its wharves and landings including the bridge's proposed location, the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built, and should any change be made in the plan of said bridge during the progress of construction such changes shall be subject to the approval of the Secretary of War: *Provided*, That the bridge already built if made to conform to the requirements of this act and the said regulations of the Secretary of War may be accepted in lieu of a new bridge.

Secretary of War to approve plan, etc.

Proviso. Existing bridge.

SEC. 4. The said company or corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

Lights, etc.

SEC. 5. That the right is reserved in Congress to amend, alter, or repeal this act at any time, without any cost or damage to the said United States.

Amendment, etc.

Approved, March 3, 1891.

CHAP. 526.—An act to authorize the building of a bridge at Van Buren, Arkansas, across the Arkansas River.

March 3, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Van Buren Pontoon Bridge Company, a corporation organized under the laws of the State of Arkansas, its successors and assigns, be, and are hereby, authorized to construct and maintain a pontoon bridge and approaches thereto across the Arkansas River in front of Van Buren, at a point at least one mile from any other similar bridge, and which shall not be detrimental to the interest of navigation or of any river improvement. Said bridge shall be constructed so as to provide for the passage of wagons and vehicles of all kinds, animals, and foot passengers, and for all road travel, for such reasonable rates of toll, and under such reasonable rules and regulations as may be prescribed by said corporation, its successors or assigns, and approved from time to time by the Secretary of War.

Van Buren Pontoon Bridge Company may bridge Arkansas River at Van Buren, Ark.

Wagon and foot bridge.

Toll, etc.

SEC. 2. That any bridge built under this act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than is charged other parties for like privileges; and it shall enjoy the rights and privileges of other post roads in the United States, and the United States shall have the right of way across said bridge and its approaches for postal telegraph purposes; and equal rights as to constructing and maintaining their lines over said bridge shall be granted to all telegraph and telephone companies desiring to use the same.

Lawful structure and post route.

Postal telegraph.

Use by telegraph and telephone companies.

SEC. 3. That said bridge shall be constructed as a pontoon draw span bridge, and shall contain a pontoon draw span of not less than three hundred feet in length, which said draw span shall be maintained on the main channel of the river at an accessible and navigable point; and the piers of said bridge shall be parallel with, and the bridge itself at right angles to, the current of the river: *Provided, also*, That said draw shall be opened promptly by the said company, upon a reasonable signal, for the passage of boats and rafts; and said company or corporation shall maintain at their own expense, from

Draw.

Provisos.

Opening draw.

Lights, etc. sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. No bridge shall be constructed or maintained under the authority of this act which shall at any time

Unobstructed navigation. substantially or materially obstruct the free navigation of said river; and if any bridge erected under said authority shall, in the opinion of the Secretary of War, obstruct such navigation, he is hereby au-

Changes. thorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction; and all such alterations shall be made and all such obstructions be removed at the expense of

Litigation. the owner or owners of said bridge; and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, caused or alleged to be caused by said bridge, suit may be brought in the district court of the United States for the western district of the State of Arkansas to remove or remedy the same: *Pro-*

Existing laws for protecting navigation. *vided further*, That nothing in this act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers, or to exempt this bridge from the operation of the same.

Secretary of War to approve plans, etc. SEC. 4. That any bridge authorized to be constructed under this act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company or corporation shall submit to the Secretary of War, for his examination and approval a design and drawings of the said bridge, and a map of the location, giving, for the space of one mile above and one mile below the proposed location, the high and low water lines upon the banks of the river, the direction and strength of the current at all stages, with the soundings, accurately showing the bed of the stream, and the location of any other bridge or bridges; such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until such plan and location of said bridge are approved by the Secretary of War the bridge shall not be commenced or built; and should any change be made in the plan of said bridge during the progress of construction, or after completion, such change shall be subject to the approval of the Secretary of War.

Amendment, etc. SEC. 5. That the right to alter, amend, or repeal this act is hereby expressly reserved, and the right to require any changes in the said structure, or its entire removal, at the expense of the owners thereof, whenever the Secretary of War shall decide that the public interest so requires, is also expressly reserved.

Commencement and completion. SEC. 6. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date thereof.

Approved, March 3, 1891.

March 3, 1891. **CHAP. 528.**—An act to provide for the examination and survey of a breakwater to form a harbor of safety and refuge in Lynnhaven Bay, near Cape Henry, at the foot of Chesapeake Bay, Virginia.

Lynnhaven Bay, Va. Survey, etc., of, for harbor of refuge. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the Secretary of War is hereby directed to cause examination and survey to be made, and the estimated cost of improvement to be estimated for a breakwater to form a harbor of safety and refuge in Lynnhaven Bay, near Cape Henry, at the foot of Chesapeake Bay, Virginia.

Approved, March 3, 1891.

March 3, 1891. **CHAP. 530.**—An act to authorize the construction of a bridge across the Eastern Branch of the Potomac River at the Bennings Road, in the District of Columbia.

Bennings Bridge, D. C. New structure authorized. *Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled*, That the Commissioners of the District of Columbia be, and they are hereby, authorized and directed to cause to be constructed across the Eastern Branch of the Potomac

River, on the Bennings Road, in the District of Columbia, a substantial stone or iron bridge, with necessary approaches; and the sum of sixty thousand dollars is hereby appropriated, out of any money in the Treasury not otherwise appropriated, which said sum shall be available immediately upon the passage of this act for the construction of said bridge and approaches, and for such investigation and surveys and such contingencies as the Commissioners of the District of Columbia shall deem necessary, the same to be maintained as a free bridge for travel.

Appropriation.

Free bridge.

SEC. 2. That the sum which shall be expended under the provisions of this act shall be treated and regarded as part of the general expenses of the District of Columbia, and the United States shall be credited with the amount which it may pay under this act upon the fifty per centum of the expenses of the District of Columbia, as provided in the act of June eleventh, eighteen hundred and seventy-eight, entitled An act providing a permanent form of government for the District of Columbia.

Half from District revenues.

Vol. 20, p. 102.

SEC. 3. That the Commissioners of the District of Columbia shall, as soon at practicable, cause a survey of said river to be made to determine the length, width, and height of said bridge and the approaches thereto, and shall cause plans and specifications to be prepared for such bridge and such approaches, and when the same are completed said Board shall advertise for sealed proposals for the construction of such bridge and such approaches, which advertisement shall be inserted for at least one week in one or more daily papers in such cities as the said Board of Commissioners shall designate, and shall let such contract to the lowest responsible bidder, as provided by law: *Provided*, That the aggregate cost for the construction of such bridge and the approaches thereto, including the incidental expenses connected therewith, shall not exceed the amount herein appropriated.

Survey.

Plans, etc.

Advertisement for proposals.

To be let to lowest bidder.

Proviso.

Limit of cost.

Approved, March 3, 1891.

CHAP. 540.—An act making appropriations to supply deficiencies in the appropriations for the fiscal year ending June thirtieth, eighteen hundred and ninety-one, and for prior years, and for other purposes.

March 3, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, to supply deficiencies in the appropriations for the fiscal year eighteen hundred and ninety-one, and for prior years, and for other objects hereinafter stated, namely:

Deficiencies appropriations.

* * * * * * *

WAR DEPARTMENT.

War Department.

* * * * * * *

BUILDINGS AND GROUNDS IN AND AROUND WASHINGTON: For introducing electric lamps and wires into the Executive Mansion and connecting the same by underground cable with the source of electricity, five thousand seven hundred and fifty dollars.

Buildings and grounds, D. C.

Executive Mansion electric lights.

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MISCELLANEOUS.

Miscellaneous.

MISSISSIPPI RIVER COMMISSION: For salaries of the Mississippi River Commission from July first, eighteen hundred and ninety, to September eighteenth, eighteen hundred and ninety, inclusive, one thousand nine hundred and fifty dollars.

Mississippi River Commission.

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WAR DEPARTMENT CLAIMS ALLOWED BY THE THIRD AUDITOR AND SECOND COMPTROLLER.

War Department claims, Third Auditor and Second Comptroller.

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For contingencies of fortifications, thirteen dollars and ninety cents.

Fortifications.

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War Department claims, Third Auditor and Second Comptroller.

WAR DEPARTMENT CLAIMS ALLOWED BY THE THIRD AUDITOR AND SECOND COMPTROLLER.

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Fortifications. For contingencies of fortifications, twenty-eight dollars.

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Approved, March 3, 1891.

March 3, 1891.

CHAP. 541.—An act making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-two, and for other purposes.

Legislative, executive, and judicial expenses, appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, in full compensation for the service of the fiscal year ending June thirtieth, eighteen hundred and ninety-two, for the objects hereinafter expressed, namely:

* * * * * * *

War Department.

WAR DEPARTMENT.

* * * * * * *

Office of Chief of Engineers.

IN THE OFFICE OF THE CHIEF OF ENGINEERS: Chief clerk, at two thousand dollars; four clerks of class four; two clerks of class three; three clerks of class two; three clerks of class one; one clerk, at one thousand dollars; one assistant messenger; and two laborers; in all twenty-three thousand two hundred and forty dollars.

Draftsmen, etc.

And the services of skilled draughtsmen, civil engineers, and such other services as the Secretary of War may deem necessary may be employed in the office of the Chief of Engineers to carry into effect the various appropriations for rivers and harbors, fortifications, and surveys for military defenses, to be paid from such appropriations: *Provided,* That the expenditures on this account for the fiscal year ending June thirtieth, eighteen hundred and ninety-two, shall not exceed sixty thousand dollars; and that the Secretary of War shall each year, in the annual estimates, report to Congress the number of persons so employed and the amount paid to each.

Proviso.

Limit.

Report.

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Public buildings and grounds.

PUBLIC BUILDINGS AND GROUNDS.

Clerk, messenger, etc.

OFFICE OF PUBLIC BUILDINGS AND GROUNDS; For one clerk, one thousand six hundred dollars; one messenger; one public gardener, one thousand eight hundred dollars; in all, four thousand two hundred and forty-dollars.

Overseers.

For overseers, draughtsman, foremen, mechanics, gardeners, and laborers employed in the public grounds, thirty thousand dollars.

Watchmen.

For day watchman in Franklin Square, six hundred and sixty dollars

For day watchman in La Fayette Square, six hundred and sixty dollars.

For two day watchmen in Smithsonian Grounds at six hundred and sixty dollars each, one thousand three hundred and twenty dollars.

For two night watchmen in Smithsonian Grounds, at seven hundred and twenty dollars each, one thousand four hundred and forty dollars.

For one day watchman at Judiciary Square, and one at Lincoln Square, and adjacent reservations, at six hundred and sixty-dollars each, one thousand three hundred and twenty dollars.

For one night watchman in Judiciary Square, seven hundred and twenty dollars.

For one day watchman at Iowa Circle; one at Thomas Circle and

neighboring reservations; one at Rawlins Square and Washington Circle; one at Dupont Circle and neighboring reservations; one at McPherson and Farragut Squares; one at Stanton Square and neighboring reservations; two at Henry Square, Seaton Square, and reservations east of Botanic Garden; one at Mount Vernon Square and adjacent reservations; one for the greenhouses and nursery; one at grounds south of Executive Mansion; eleven in all, at six hundred and sixty dollars each, seven thousand two hundred and sixty dollars.

For one night watchman at Henry (Armory) and Seaton Squares and reservations east of Botanic Garden, seven hundred and twenty dollars.

For one night watchman at Garfield Park, seven hundred and twenty dollars.

For contingent and incidental expenses, five hundred dollars. Contingent expenses.

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Approved, March 3, 1891

CHAP. 542.—An act making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-two, and for other purposes. March 3, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and ninety-two, namely: Sundry civil expenses appropriations.

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MISCELLANEOUS OBJECTS UNDER THE TREASURY DEPARTMENT. Miscellaneous objects under the Treasury Department.

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QUARANTINE SERVICE. Quarantine service.

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And the Secretary of War is hereby directed to assign to the Secretary of the Treasury so much space on the Lewes iron pier as may be necessary to enable the Marine Hospital Service to establish and conduct thereon such disinfection machinery as may be required for the proper disinfection of the cargoes of vessels detained at the quarantine, and when the breakwater shall have been completed then the said pier shall be permanently assigned to the Treasury Department: *Provided*, That such occupation and use of the pier by the Marine Hospital Service does not interfere with the engineering operations of the War Department in the completion of the breakwater improvement.

Lewes iron pier.

Assignment of space for disinfection machinery.

Proviso.

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UNDER THE WAR DEPARTMENT. Under the War Department.

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BUILDINGS AND GROUNDS IN AND AROUND WASHINGTON. Buildings and grounds, Washington, D. C.

For the improvement and care of public grounds, as follows:

For improvement of grounds north of Executive Mansion, one thousand dollars

For improvement and maintenance of grounds south of the Executive Mansion, four thousand dollars.

For ordinary care of greenhouses and nursery, two thousand dollars.

For ordinary care of Lafayette Square, one thousand dollars.

For ordinary care of Franklin Square, one thousand dollars.

For granite curbing about Lafayette square, five thousand dollars.

For care and improvement of Monument grounds, five thousand dollars; Improvement and care.

Reservation No. 17, etc.

For continuing improvement of reservation numbered seventeen and site of old canal northwest of same, five thousand dollars: *Provided*, That no part thereof shall be expended upon other than property belonging to the United States.

Proviso.
Limit.

For construction and repair of post-and-chain fences, and constructing stone coping around reservations, one thousand five hundred dollars.

For manure and hauling the same, five thousand dollars.

For painting watchmen's lodges, iron fences, vases, lamps, and lamp posts, seven hundred and fifty dollars.

For purchase and repair of seats, one thousand dollars.

For purchase and repair of tools, two thousand dollars.

For trees, tree and plant stakes, labels, lime, whitewashing, and stock for nursery, three thousand dollars.

For removing snow and ice, one thousand two hundred dollars.

For flowerpots, twine, caskets, wire, splints, moss, and lycopodium, one thousand dollars.

For care, construction, and repair of fountains, one thousand five hundred dollars.

For abating nuisances, five hundred dollars.

For improvement, care, and maintenance of various reservations, twelve thousand dollars.

For improvement, maintenance, and care of Smithsonian Grounds, including construction of asphalt roads and paths, eight thousand dollars.

For improvement, care, and maintenance of Judiciary Square, including grounds around Pension Building and asphalt roads and walks leading to Pension Building, five thousand dollars.

For replacing the old flagging pavement of the sidewalk on Pennsylvania avenue in front of the Executive Mansion by a grandolithic pavement, seven thousand five hundred dollars.

Concrete, etc., pavements.

Limit of cost.

That under appropriations herein contained no contract shall be made for making or repairiug concrete or asphalt pavements in Washington City at a higher price than two dollars and twenty-five cents per square yard for a quality equal to the best laid in the District of Columbia prior to July first, eighteen and eighty-six, and with a base not less than six inches in thickness.

Executive mansion.

Repairs, refurnishing, etc.

For repairs and fuel at the Executive Mansion as follows:

For care, repair, and refurnishing the Executive Mansion, thirty-five thousand dollars, to be expended by contract or otherwise as the President may determine.

Fuel.

For fuel for the Executive Mansion, greenhouses, and stable, three thousand dollars.

For care and necessary repair of greenhouses, five thousand dollars.

Lighting Executive Mansion and public grounds.

LIGHTING THE EXECUTIVE MANSION AND PUBLIC GROUNDS: For gas, pay of lamp lighters, gas fitters, and laborers; purchase, erection, and repair of lamps and lamp posts; purchase of matches, and for repairs of all kinds; fuel and lights for office, office stables, watchmen's lodges, and for the greenhouses at the nursery, fourteen thousand dollars: *Provided*, That for each six-foot burner not connected with a meter in the lamps on the public grounds no more than twenty-one dollars and fifty cents shall be paid per lamp for gas, including lighting, cleaning, and keeping in repair the lamps, under any expenditure provided for in this act; and said lamps shall burn not less than three thousand hours per annum; and authority is hereby given to substitute other illuminating material for the same or less price, and to use so much of the sum hereby appropriated as may be necessary for that purpose: *Provided*, That before any expenditures are made from the appropriations herein provided for, the contracting gas companies shall equip each lamp with a self-regulating burner and tip, so combined and adjusted as to secure, under all ordinary variations of pressure and density, a consumption of six cubic feet of gas per hour.

Provisos.

Maximum price per lamp.

Gas consumption.

Electric lights.

For electric lights for three hundred and sixty-six nights from seven posts, at forty cents per light per night, one thousand and twenty-four dollars and eighty cents.

Water pipes, etc.

REPAIR OF WATER PIPES: For repairing and extending water pipes, purchase of apparatus, for cleaning them, purchase of hose, and cleaning the springs and repairing and renewing the pipes of the same that supply the Capitol, the Executive Mansion, and the building for the State, War, and Navy Departments, two thousand five hundred dollars.

TELEGRAPH TO CONNECT THE CAPITOL WITH THE DEPARTMENTS AND GOVERNMENT PRINTING OFFICE: For care and repair of existing lines, one thousand two hundred and fifty dollars. Government telegraph.

WASHINGTON MONUMENT: For the care and maintenance of the Washington Monument, namely: For one custodian, at one hundred dollars per month; one steam engineer at eighty dollars per month; one assistant steam engineer, at sixty dollars per month; one fireman, at fifty dollars per month; one assistant fireman, at forty-five dollars per month; one conductor of elevator car, at seventy-five dollars per month; one attendant on floor, at sixty dollars per month; one attendant on top floor, at sixty dollars per month; three night and day watchmen, at sixty dollars per month each; in all, eight thousand five hundred and twenty dollars. Washington Monument. Care and maintenance.

For fuel, lights, oil, waste, packing, tools, matches, paints, brushes, brooms, lanterns, rope, nails, screws, lead, electric lights, heating apparatus, oil stoves for elevator car and upper and lower floor, repairs to engines, boilers, dynamos, elevator, and repairs of all kinds connected with the monument and machinery, and purchase of all necessary articles for keeping the monument, machinery, elevator, and electric-light plant in good order, three thousand dollars. Expenses.

For an extra set of cables for elevator, one thousand three hundred dollars. Extra cables.

ENGINEER DEPARTMENT.

Engineer Department.

For improving harbor at Philadelphia, Pennsylvania: Continuing improvement; removal of Smith's Island and Windmill Island, Pennsylvania, and Petty's Island, New Jersey, and adjacent shoals, three hundred thousand dollars: *Provided*, That the plan for the improvement may be modified by changing the line limiting the excavation on Betty's Island to such position as the Secretary of War may consider desirable, and the material to be removed from said islands and shoals under this appropriation and appropriations heretofore made shall be deposited and spread on League Island and to the extent of the cost of such deposit and spreading the said appropriotions are hereby made available: *Provided further*, That the title to any additional lands acquired for this purpose shall be vested in the United States without charge to the latter. Rivers and harbors. Continuing improvements, harbor at Philadelphia, Pa. *Provisos.* Modification of plan. Deposit of material on League Island. Available appropriations. Title.

For improving harbor at Baltimore, Maryland: Continuing improvement, one hundred and fifty-one thousand two hundred dollars. Harbor at Baltimore, Md.

For improving harbor at Galveston, Texas: Continuing improvement to entrance to harbor, six hundred thousand dollars. Harbor at Galveston, Tex.

For improving Saint Mary's River, Michigan: Continuing improvement to Saint Mary's Falls, six hundred thousand dollars. Saint Mary's River, Mich.

For improving Hay Lake Channel, Saint Mary's River, Michigan: Continuing improvement, three hundred thousand dollars. Hay Lake Channel, Mich.

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YELLOWSTONE NATIONAL PARK: For the improvement of the Yellowstone National Park, seventy-five thousand dollars, the same, together with the unexpended balance of appropriations already made, to be expended by and under the direction of the Secretary of War. Yellowstone National Park. Available balances.

For the repair, maintenance, relocation, and completion of roads, bridges, and paths already in use and necessary to reach objects of natural interest in the Park; Repair, etc., roads, etc.

For the construction of a road from Grand Canon to Yellowstone Lake outlet, thence to the thumb of the Yellowstone Lake, thence by the shortest practicable route to Fountain Geyser; any unexpended balance to be applied to the construction of additional roads, bridges, footways, and bridle paths, as the public service may require, in the discretion of the Secretary of War. Road from Grand Canon to Fountain Geyser. Additional roads.

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MISCELLANEOUS OBJECTS.

Miscellaneous objects.

SURVEY OF NORTHERN AND NORTHWESTERN LAKES: For printing and issuing charts for use of navigators and electrotyping plates for chart printing, two thousand dollars. Survey, lakes.

For surveys, additions to, and correcting engraved plates, ten thousand dollars.

Transporting reports, etc.

TRANSPORTATION OF REPORTS AND MAPS TO FOREIGN COUNTRIES: For the transportation of reports and maps to foreign countries, through the Smithsonian Institution, one hundred dollars.

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New York Harbor.
Injurious deposits.
Pay of inspectors, etc.
Steamer "Argus;" pay of crew, etc.
Steamer "Nimrod;" pay of crew, etc.

HARBOR OF NEW YORK: For prevention of obstructive and injurious deposits within the harbor and adjacent waters of New York City:

For pay of inspectors and deputy inspectors, office force, and expenses of office, fifteen thousand dollars;

For pay of crew and maintenance of steamer Argus, eight thousand dollars;

For pay of crew and maintenance of steamer Nimrod, ten thousand dollars; in all, thirty-three thousand dollars.

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Building for Library of Congress.
Continuing construction.

BUILDING FOR THE LIBRARY OF CONGRESS.

For continuing the construction of the building for the Library of Congress, and for each and every purpose connected with the same, six hundred thousand dollars.

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Public printing and binding.

PUBLIC PRINTING AND BINDING.

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Exclusion of unnecessary, etc., matter.

and the heads of the Executive Departments, before transmitting their annual reports to Congress, the printing of which is chargeable to this appropriation, shall cause the same to be carefully examined, and shall exclude therefrom all matter, including engravings, maps, drawings, and illustrations, except such as they shall certify in their letters transmitting such reports to be necessary and to relate entirely to the transaction of public business

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Approved, March 3, 1891.

March 3, 1891.

CHAP. 546.—An act making appropriations to provide for the expenses of the government of the District of Columbia for the fiscal year ending June thirty, eighteen hundred and ninety-two, and for other purposes.

District of Columbia appropriations.
Half from District revenues.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the half of the following sums named, respectively, is hereby appropriated, out of any money in the Treasury not otherwise appropriated, and the other half out of the revenues of the District of Columbia for the purposes following, being for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety-two, namely:

GENERAL EXPENSES.

Salaries, etc.

FOR SALARIES AND CONTINGENT EXPENSES.

Executive office.
Commissioners, secretary, etc.

FOR EXECUTIVE OFFICE: For two Commissioners, at five thousand dollars each; one Engineer Commissioner, four hundred and twenty-four dollars (to make salary five thousand dollars);

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Aqueduct.

WASHINGTON AQUEDUCT.

Engineering, etc.

For engineering, maintenance, and general repairs, twenty thousand dollars.

* * * * *

Approved, March 3, 1891.

CHAP. 553.—An act authorizing the Coos Bay, Roseburgh and Eastern Railway and Navigation Company, in the county of Coos, State of Oregon, to construct a bridge across the Coal Bank Slough, in said State.

March 3, 1891.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Coos Bay, Roseburgh and Eastern Railway and Navigation Company, a corporation organized and existing under the laws of the State of Oregon, its successors and assigns, be, and is hereby, authorized to construct and maintain a bridge across the Coal Bank Slough, at such point as may be selected on said stream in Coos County, in said State of Oregon: *Provided*, That said bridge shall not interfere with the free navigation of said stream and in case of any litigation arising from any obstruction, or alleged obstruction, to the free navigation of said slough by reason of the construction of said bridge, the cause may be tried before the circuit court of the United States in and for the district in whose jurisdiction any portion of said obstruction or bridge may be.

Coos Bay, Roseburgh, and Eastern Railway and Navigation Company may bridge Coal Bank Slough, Oregon.

Proviso.

Free navigation.

Litigation.

SEC. 2. That such bridge, built under the provisions of this act, may be built as a drawbridge, or with unbroken, continuous spans, as the Secretary of War may direct: *Provided*, That if such bridge shall be made with unbroken, continuous spans the main span shall be over the main channel of such navigable stream, and shall be of such width and the lowest part of the superstructure shall be of such height above extreme high-water mark as the Secretary of War may prescribe, and such bridge shall be at right angles to, and its piers parallel with, the channel or current of said river. And if such bridge, built under this act, shall be constructed as a drawbridge, the same shall be constructed with the opening over the center or channel of the river, and shall be of such width and character of construction as the Secretary of War shall prescribe, and the piers of such bridge shall be parallel with the current, and the draw of such bridge shall be over the main or deep channel of the stream: *Provided, also*, That said draw shall be opened promptly upon a reasonable signal for the passage of boats, and in no case shall unnecessary delay occur in opening said draw.

Construction.

Provisos.
Spans.

Draw.

Opening draw.

And said Coos Bay, Roseburgh and Eastern Railway and Navigation Company shall maintain at its own expense, from sunset to sunrise, such lights or other signals on such bridge as the Light-House Board shall prescribe: *Provided, also*, That said bridge, at the option of the said railroad company, may be used for the passage of wagons or vehicles of all kinds, for the transit of animals and foot passengers for such reasonable rate of toll as may be approved from time to time by the Secretary of War, but the same may, at the option of the said company, be a free bridge for the passage of vehicles and foot passengers thereon.

Lights, etc.

Railway, wagon, and foot bridge.

Toll, etc.

SEC. 3. That the bridge authorized to be constructed under this act shall be a lawful structure, and shall be recognized and known as a post-route, and shall enjoy the rights and privileges of other post-roads in the United States and no higher charge shall be made for the transmission over the same of the mails, troops, or munitions of war of the United States or for other passengers or freight passing over said bridge than the rate per mile paid for transportation over any railroad leading to said bridge. And the United States shall have the right of way for a postal telegraph across said bridge and its approaches.

Lawful structure and post-route.

Postal telegraph.

Said bridge shall be built and located under and subject to such regulations for the security of navigation on navigable rivers as the Secretary of War shall prescribe. To secure that object the said company shall submit to the Secretary of War, for his examination and approval, a design and drawing of such bridge, and a map of the location, giving, for the space of one mile above and one mile below the location, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current at all stages, and the soundings, accurately showing the bed and channel of the stream, and the location of any other bridge or bridges, such map to be sufficiently in detail to enable the Secretary of War to judge of the proper location of said bridge, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject. And until the said plans and location of the bridge are approved by the Secretary of War the bridge shall not be built or commenced, and any change made in the plans of such bridge during the progress of the work thereon shall be subject to the approval of the Secretary of War.

Secretary of War to approve plans, etc.

Changes, etc.

That such alterations or changes as may be required by the Secretary of War or Congress in the bridge constructed under the provisions of this act shall be made by the said company at its own expense.

Aids to navigation.

SEC. 4. That said company or any corporation or persons owning, controlling, or operating the bridge built under the authority of this act shall build and maintain at all times as accessory works to said bridge such booms, piers, dikes, guard fences and similar devices as may be necessary to insure at all times a permanent channel for a sufficient distance above and below the bridge site, and for guiding of rafts, steamboats, and other water craft safely under or through said bridge as may be prescribed by the Secretary of War.

Use by other railroads.

SEC. 5. That in case the bridge authorized by this act shall be constructed to provide for the passage of railroad trains, then all railroad companies desiring the use of the bridge shall have and be entitled to equal rights and privileges relative to the passage of railway

Terms.

trains or cars over the same, and over the approaches thereto, upon the payment of a reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of them desiring such use fail to agree upon the sum or sums to be paid, and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs

Secretary of War to decide disagreements.

of the parties; and equal privileges in the use of said bridge and approaches shall be granted to all telegraph and telephone companies.

Commencement and completion.

SEC. 6. That this act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of approval thereof.

Amendment, etc.

SEC. 7. That the right to alter, amend, or repeal this act is hereby expressly reserved; and the right to require the entire removal of the bridge constructed under the provisions of this act, at the expense of the owners thereof, whenever Congress shall decide that the public interests require it, is also expressly reserved.

Approved, March 3, 1891.

March 3, 1891. **CHAP. 554.—An act authorizing the construction of a railway upon the Government reservation at Fort Monroe, Virginia.**

Hampton and Old Point Railway Company granted right of way, Fort Monroe, Va.
Vol. 25, p. 1011.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized to grant permission to the Hampton and Old Point Railway Company, a corporation chartered by the general assembly of Virginia, to construct, maintain, and operate a street

Street railway.

railway over and upon the lands of the Government reservation at Fort Monroe, Virginia, upon such location and upon such plans, dimensions, conditions, and requirements as may be prescribed and approved by

Provisos.

the Secretary of War: *Provided*, That said railway shall cross Mill

Mill Creek bridge.

Creek upon a bridge separate and distinct from the existing bridge owned by the United States, to be constructed upon plans to be approved by the Secretary of War: *And provided further*, That the rates

Fare.

of transportation shall not exceed ten cents for each passenger for one continuous ride over the entire route of said railway, but the rates may be reduced by the Secretary of War: *And provided further*, That

Privileges may be rescinded.

the privileges hereby granted may at any time be rescinded or suspended by order of the Secretary of War; and said corporation shall, at any time, when so ordered by the Secretary of War, remove its rails and all other fixtures and appurtenances at its own expense and cost without any claim of any kind whatever for any loss, damage, or compensation of any kind from the United States.

Completion.

SEC. 2. That the grants and privileges mentioned in this act shall be determined and become void unless the said railway shall be completed and put in operation from Hampton, Virginia, to the terminus upon the Government lands at Fort Monroe, Virginia, within two years from the passage of this act.

Amendment, etc.

SEC. 3. That this act shall be subject to alteration, amendment, or repeal at any time at the pleasure of Congress.

Approved, March 3, 1891.

RESOLUTIONS.

[No. 7.] Joint resolution defining a quorum of the Board of Commissioners of the District of Columbia, and for other purposes.

December 24, 1890.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That any two of the Commissioners of the District of Columbia, sitting as a board, shall constitute a quorum for the transaction of business, and that the senior officer of the Corps of Engineers of the Army who shall for the time being be detailed to act as assistant (and in case of his absence from the District or disability, the junior officer so detailed) shall, in the event of the absence from the District or disability of the Commissioner who shall for the time being be detailed from the Corps of Engineers, perform all the duties imposed by law upon said Commissioner. Hereafter such Engineer Commissioner may, in the discretion of the President of the United States, be detailed from among the captains or officers of higher grade having served at least fifteen years in the Corps of Engineers of the Army of the United States.

Commissioners of the District of Columbia.

Quorum of board.

Acting Engineer Commissioner.

Engineer Commissioner may be appointed from captains.

Approved, December 24, 1890.

[No. 13.] Joint resolution correcting an error in an enrolled bill

March 2, 1891.

Whereas the act to incorporate the Washington and Arlington Railway Company, as enrolled, fails to express the intent of the two houses as manifested by the adoption of the report of the conference committee on the amendments between the two houses thereon: Now, therefore, for the purpose of correcting said error and for no other purpose,

Preamble.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That section four of the act entitled "An act to incorporate the Washington and Arlington Railway Company of the District of Columbia" be, and same is hereby, amended so that the last sentence of said section after the words "in accordance herewith" shall read as follows: "And bonds to be secured by mortgage or deed of trust upon the property of the company may be issued to the amount of five hundred thousand dollars: *Provided*, That the entire issue of stock and bonds shall not exceed the actual cost of constructing and equipping the road, including the bridge: *And provided also*, That the total amount of bonds issued shall not exceed double the amount of paid up stock, and every certificate of stock shall show the amount paid on the same.

Washington and Arlington Railway Company.

Error in enrollment of charter corrected.

Ante, p. 496.

Approved, March 2, 1891.

[No. 18.] Joint resolution authorizing the State of Oregon to construct, maintain and operate a portage railroad over the property of the United States at the Cascades of the Columbia River, Oregon.

March 3, 1891.

Resolved, by the Senate and House of Representatives of the United States of America in Congress assembled, That the State of Oregon is hereby authorized to construct, maintain and operate a portage railroad over the lands belonging to the United States at the Cascades of the Columbia River in the State of Oregon and to use in the construction of the same and in the operation thereof, the Government roads upon said lands: *Provided*, That such occupation and use shall not interfere with the Government works at said Cascades, and shall be under such restrictions and regulations as the Secretary of War shall prescribe.

Oregon.

May build portage railroad over United States lands at Cascades of Columbia River.

Proviso.

Non-interference with Government works.

Approved, March 3, 1891.

[No. 19.] Joint resolution appropriating one million dollars for the improvement of the Mississippi River and making the same immediately available

March 3, 1891.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the sum of one million dollars is hereby appropriated, to be paid out of any money in the Treasury not otherwise appropriated, for the improvement of the Mississippi River from the Head of the Passes to the mouth of the Ohio River, which sum shall be immediately available and shall be expended under

Mississippi River.

Appropriation for improvement from Head of the Passes to Ohio River.

the direction of the Secretary of War in accordance with the plans, specifications, and recommendations of the Mississippi River Commission: *Provided*, That no portion of this appropriation shall be expended to repair or build levees for the purpose of reclaiming lands or preventing injury to lands or private property by overflows: *Provided, however*, That the commission is authorized to repair and build levees, if in their judgment it should be done, as part of their plans to afford ease and safety to the navigation and commerce of the river and to deepen the channel: *Provided further*, That the office, clerical, and traveling expenses and salaries of the Mississippi River Commission may be paid from this appropriation.

Provisos.

Repairing levees.

Salaries, Mississippi River Commission.

Approved, March 3, 1891.

PRIVATE ACTS.

January 19, 1891.

CHAP. 81.—An act for the relief of Stubbs and Lackey.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of the Treasury be directed to pay to Albert Stubbs and Job Lackey, of Lebanon, Ohio, the sum of two thousand one hundred and twenty-eight dollars and eighty-seven cents, in full of all work done by them, or by John B. Holbrook, in building a dike at Merriam Bar, and dams at Captina and Fish Creek Islands, in the Ohio River; and there is hereby appropriated, for such purposes, out of funds otherwise unappropriated and lying in the Treasury, the sum of two thousand one hundred and twenty-eight dollars and eighty-seven cents.

Albert Stubbs and Job Lackey. Payment to.

Approved, January 19, 1891

February 13, 1891.

CHAP. 175.—An act for cancellation of contract with United States engineer for delivery of stone for the improvement of the mouth of the Columbia River in Oregon and Washington.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is hereby, authorized to cancel a certain contract entered into by and between the Oregon Paving and Contract Company, of the one part, and Captain Charles F. Powell, United States Engineer, acting for and on behalf of the United States, of the other part, and dated the second day of June, anno Domini eighteen hundred and eighty-seven, whereby said Oregon Paving and Contract Company contracted to furnish a certain amount of stone of certain dimensions to be used in the improvement of the mouth of the Columbia River, Oregon, on such terms as he may deem equitable and just.

Oregon Paving and Contract Company. Cancellation of contract with.

Approved, February 13, 1891.

RESOLUTION.

March 3, 1891.

[No. 24.] Joint resolution authorizing Brigadier-General Thomas L. Casey, Chief of Engineers, United States Army, to accept from the President of the French Republic a diploma conferring the decoration of officer of the National Order of the Legion of Honor.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That Brigadier-General Thomas L. Casey, Chief of Engineers, United States Army, is hereby authorized to accept from the President of the French Republic a diploma conferring upon him the decoration of officer of the National Order of the Legion of Honor.

Thomas L. Casey. May accept decoration of Legion of Honor from President of France.

Approved, March 3, 1891.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

APPENDIXES

TO THE

REPORT OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY.

FORTIFICATIONS, ETC.

APPENDIX NO. 1.

PROTECTION OF SITE OF FORT NIAGARA, NEW YORK.

REPORT OF CAPTAIN DAN C. KINGMAN, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 10, 1891.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1891, for fortifications in my charge.

* * * * * * *

Very respectfully, your obedient servant,

DAN C. KINGMAN,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

PROTECTION OF SITE OF FORT NIAGARA.

Operations have been in progress for the protection of the site of Fort Niagara, under an allotment from the appropriation for "sea walls and embankments." The project for this work was approved November, 1888, and is briefly as follows:

First. To build a dike of stakes and fascines, paved on the top with stone, and held at a reference 2.0 feet of the Lake Ontario gauge, from the northwest bastion of Fort Niagara to the northerly angle of the

wharf, and to demolish the wall that makes the western front of the fort and use its material as a riprap and filling behind the dike.

Second. To build a similar dike from the southern end of the light-house reservation towards the southern end of the military reservation of Fort Niagara, as the means available will permit, and to fill in behind the dike a bank of low slope to reference 6.0 feet, Lake Ontario gauge; to grade the bank above to a steep slope leading between the two slopes such roadway as may be desirable for the use of the post; to plant the lower slope with willows and the upper one with grass.

Estimated cost per 100 feet, $750. Subsequently this project was modified by substituting iron pipes for the wooden stakes used to secure the fascines. This greatly increased the durability of the work, but it also increased its cost to about $10 per running foot.

The project was also extended to include the repair of the retaining wall at the northwest angle of the fort and to make all necessary repairs to the same along the lake front.

The amount expended under this project to July 1, 1891, is $18,311.05, and has resulted in the construction of 1,711 linear feet of dike work along the lake and river front, 941 feet of which along the river front requires the filling and grading as above described.

The total cost of this work was $11,873.60. In addition, repairs have been made to the wall at the northwest angle, as described in full in the report of operations below.

OPERATIONS.

July 1 to July 23, 1890:

The revetment on lake front, east of fort, 214 feet in length, which was built in May and June, received some additional work, costing for service, $74.75.

July 23 to 30 and August 29 to September 5, 1890:

The crib-work base for northwest angle breakwater, 70 feet long, 14 feet wide, and 3 courses or 3 feet deep, was built on ways upon the wharf and completed ready to be launched when stage of water should permit of construction of its concrete superstructure.

It cost for material	$304.24
For services	148.36
Total	452.60

It has not yet been launched.

July 1 to August 29, 1890:

The rebuilding of the masonry forming the exposed northwest angle of Fort Niagara was prepared for in July and August by clearing away the débris, building a cofferdam in the lake around its base, and collecting gravel and sand for use in its construction.

The cofferdam was repeatedly broken before masonry work was begun, by the waves to which it was fully exposed:

It cost for material	$23.35
For services	223.66
Total	247.01

July 1 to August 29, 1890:

The clearing of foundation and collection of sand and gravel, and the picking up and cleaning of stone from the fallen wall:

Cost of all, for services	$763.11

September 23 to December 6, 1890:

The rebuilding of the northwest angle and its bonding into the por-

tion of the wall still standing was done between these dates. Most of the stone used had to be cut for the purpose. The lower 7 feet of the wall, being below lake level, was difficult of construction, through its being in so exposed a location, the cofferdam being six times broken by storms while masonry was in progress.

The new portion of wall was brought into bearing beneath the overhanging portion of the old wall by driving 100 flat iron wedges beneath the projections of the old work, keeping the iron well back from face to avoid iron-rust stains.

The wall thus rebuilt is 40 feet in length, 39½ feet in height from its foundation on hard pan at 3⅓ feet below extreme low-water level, and is 8 feet thick at base and 4 feet at top; about 350 cubic yards in all. It was finished except coping and pointing. Burham Portland cement was used, costing $3.51 per barrel, delivered on work.

The cost has been—

Material	$819.20
Services, not including clearing foundation and building cofferdam before stated	2,345.99
Total	3,165.19

or $9 per cubic yard, which rate is moderate considering the character of the work.

It is intended to point and cope the wall and to build the concrete breakwater in front of it as soon as the lowering stage of water in the lake permits.

REMARKS.

The present season's work will be the completion of the wall at the northwest angle of the fort which was in progress at the close of the working season and the repair of the sea wall along the lake front of the fort. In this work it will be necessary to fill a large number of cavities at or just below the water line, which have been formed by the removal of stone from the wall by the action of the waves.

This will probably cost about $5,500. The remainder of the funds available will be applied to extending the shore protection work of brush and stone, and to completing by grading, filling, etc., some portion of this work that is already begun. In pursuance of the project of November, 1888, some 154 linear feet of the detached wall that forms the western front of the work was torn down and the stone used to fill in behind the dike.

This makes a very conspicuous and unsightly breach and leaves the work entirely open and easy of entrance on this side. There is plenty of stone right at hand that would do perfectly well to fill in behind the dike, and I would recommend that this wall be restored. The cost would not exceed $3,000. Ten thousand dollars in addition, if that sum were available, could be advantageously applied to the extension of the work of protecting the site.

Money statement.

July 1, 1890, balance unexpended	$8,126.40
Amount allotted October 11, 1890	10,000.00
	18,126.40
July 30, 1891, amount expended during fiscal year	6,437.45
July 1, 1891, balance unexpended	11,688.95
July 1, 1891, balance available	11,688.95
Amount (estimated) required for completion of existing project	26,105.30
Amount that can be profitably expended in fiscal year ending June 30, 1893	13,000.00

APPENDIX No. 2.

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR. SEA WALL AT GOVERNORS ISLAND, NEW YORK HARBOR.

REPORT OF COLONEL DAVID C. HOUSTON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

IMPROVEMENTS.

a. Sea wall at Davids Island, New York Harbor.

b. Sea wall at Governors Island, New York Harbor.

ENGINEER OFFICE, U. S. ARMY,
New York, July 10, 1891.

GENERAL: I have the honor to transmit herewith annual reports upon * * * sea walls at Davids and Governors islands, New York Harbor.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

2 A.

SEA WALL AND EMBANKMENT AT DAVIDS ISLAND, NEW YORK HARBOR.

This island, which is occupied by the recruiting service of the Army, lies at the head of Long Island Sound, about opposite New Rochelle, and is 21 miles distant by water from the Battery, New York City. In 1883, upon recommendation of the depot surgeon, an estimate for a sea wall was transmitted to Congress, papers concerning which were printed in House Ex. Doc. No. 205, Forty-eighth Congress, second session. The recommendation was renewed in 1884. The object first stated was to prevent the collection of garbage and refuse matter upon the shores; the second recommendation stated as an additional and important object, the preservation of a fresh-water pond from overflow by the sea at high tides. The pond was separated from the Sound by a narrow beach which was not high enough to prevent waves breaking over. This pond, formerly used as a water supply, is now used chiefly for obtaining ice. An additional object of the sea wall is the reclamation of about 2 acres of low marshy land, which the embankment was intended to fill up.

In 1886 a revised estimate of cost was presented, as follows:

1,000 linear feet of wall, at $35 per foot	$35,000
40,000 cubic yards of earth embankment, at 30 cents per cubic yard	12,000
Total	47,000

The plan then was to build the wall of masonry and carry it to 12 feet above mean low-water level. The mean rise of tide is 7.3 feet.

Under the appropriation for sea walls and embankments, made by act of Congress approved September 22, 1888, an allotment of $47,000 was made for the above work. The plan of construction of sea wall was modified to one for a riprap wall of outer slope 1 on 2, inner slope 1 on 1, to be built to 10 feet above low water and capped with a course of dimension stone, 2 feet thick and 6 feet wide. The originally designed vertical masonry wall was intended to prevent the lodgment of garbage, etc., but the stringent regulations concerning the disposal of such matter, now being enforced in the harbor of New York and adjacent waters, will prevent any nuisances of that kind; and the riprap wall was considered equally efficient for every other purpose and more economical.

The sea wall was completed in April, 1890, and at the date of the last annual report work upon the embankment was in progress under a contract with John Sheehan, of New Rochelle, N. Y.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The contract with John Sheehan, dated June 1, 1889, for delivering material and making the embankment at the rate of 40 cents per cubic yard of material measured in the bank, was completed September 13. During the fiscal year 3,555 cubic yards of filling was delivered in the embankment and accepted.

PRESENT CONDITION.

The sea wall is 954 feet long and contains 9,068 tons of riprap and 953.7 linear feet of capping stones 2 feet thick and 6 feet long, stretching across the wall; its height is 12 feet above mean low water—about $4\frac{3}{4}$ feet above mean high water. The wall is in good condition; it has settled slightly in places, owing to the softness of the foundation on which it rests, but not enough to need repair.

The embankment contains 31,836 cubic yards of filling.

During the past winter, two unusually high tides, during easterly storms, broke over the sea wall and carried away a small amount of the filling from close to the wall.

PROPOSED OPERATIONS.

Nothing further is contemplated in regard to the sea wall and embankment east of the fresh-water pond, except such slight repairs as may from time to time be needed.

Money statement.

July 1, 1890, balance unexpended	$15,798.94
June 30, 1891, amount expended during fiscal year	4,201.08
July 1, 1891, balance unexpended	11,597.86
July 1, 1891, balance available	11,597.86
Amount (estimated) required for completion of project, submitted June 30, 1891	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	55,000.00

Abstract of contract for embankment at Davids Island, New York Harbor, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date of contract.	Subject of contract.	Price per cubic yard measured in place.	Remarks.
John Sheehan, New Rochelle, N. Y.	June 1, 1889	Delivering material and making embankment.	$0.40	Contract completed September 13, 1890.

SURVEY OF DAVIDS ISLAND, NEW YORK HARBOR, FOR SEA WALL ON THE WEST SIDE AND AT OTHER POINTS.

On March 2, 1891, Capt. C. P. Miller, assistant quartermaster, U. S. Army, in reporting upon a visit of inspection to Davids Island, made during the preceding month, stated that—

> The bank of the shore is washing and requires protection to make this ground perfectly safe. A sea wall built by the engineers would be the best, being permanent, but if this can not be obtained a timber breakwater would answer for some years. * * * I would recommeud that the matter of shore protection be brought to the attention of the Chief of Engineers.

This was referred by the Quartermaster-General to the Chief of Engineers and by him referred to me for remark, and in the third indorsement upon the paper, dated March 20, 1891, I stated that—

> It appears, upon inquiry, that the locality referred to is on the west side of the island, north of the coal wharf. From the information available it is estimated that the high-water line in this vicinity for a distance of about 1,200 feet has receded from 30 to 75 feet since 1878. The material on the shore is such that this erosion will continue unless checked. There can be no doubt that this action should be arrested, and that the ground already lost should be reclaimed as far as practicable. No correct estimates can be made of the cost of a permanent sea wall without a survey, and no funds are available for such a work.
>
> There are other places which need protection, and if a survey is made I would suggest that it extend entirely around the island. The estimated cost of such a survey is $500.
>
> The existing maps do not furnish the necessary information for estimates.

The estimated amount for the survey was allotted from the appropriation of August 18, 1890, for preservation and repair of fortifications, and a survey of the entire shore line of the island was completed at the close of the fiscal year. It has been partly platted, sufficiently to obtain data for estimates (submitted herewith) for sea walls and embankments.

The place where the bank has been and is caving most is a stretch of about 600 feet, extending northeasterly from a point 450 feet northeast from the upper, or coal, wharf, on the west side of the island; erosion has been going on for at least 15 years, as shown by comparison with an old map of the island, and during storm tides of last winter it was greater than usual—from 10 to 15 feet in places—and washed away part of a road on top of the bank. Undoubtedly the preservation of the property requires that this part of the shore should be protected. It can best be done by building a straight wall 1,100 feet long, extending northeasterly from the shore end of the coal wharf; such a wall should be built in the same manner and to the same height as the wall recently built on the east side of the island, but with capping-course 3 or 4 feet wide instead of 6 feet, the exposure being less; it would cost about $16,000 and the embankment behind it, to reclaim the lost land, would cost $14,000—total cost estimated at $30,000. About 1½ acres of land would be added to the available area of the island. The bottom is all

hard sand with exception of about 150 feet where it is muddy sand from 2 to 8 feet deep.

By carrying the wall out over a sand spit north of the coal wharf 2½ acres additional could be reclaimed, at an additional cost of $25,000, chiefly for embankment; it would have no special advantage over the straight wall, except the land gained.

The most economical protection for the shore at this point would be secured by building a breakwater extending about 600 feet from shore at a point 1,200 feet northeast from the coal wharf, which would cost $18,000. It would form a still-water basin where four sewers now empty and would necessitate extending or removing the sewers.

A wall is desired on the north end of the island between two rocky points about 500 feet apart; this ought to be considered in any general plan for protecting the island, but the caving at that point is not rapid now. The cost of a wall 500 feet long, with embankment which would reclaim about three-fourths of an acre of land, is estimated at $14,000.

There is a small bay on the northeast end of the island where some protection will be needed, but the urgency is not immediate. A wall 300 feet long at that point, with embankment behind it, would cost $11,000.

As soon as practicable a detailed report upon the survey will be forwarded with this map, and with a consideration of such protection as is now or is likely to be needed.

SUMMARY.

The only protection which requires consideration at once is for that part of the shore extending about 1,100 feet northeast from the coal wharf. This can, in my opinion, best be secured by building a riprap wall with capping course 2 feet thick and 3 or 4 feet wide, the top to be 12 feet above mean low water, and filling in behind the wall, at an estimated cost of $30,000.

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2 B.

SEA WALLS ON GOVERNORS ISLAND, NEW YORK HARBOR.

The shores of this island were frequently covered with offal and garbarge, which, drifting up at high water and decaying in the sun as the tide fell, were (in summer) a source of constant danger to the health of the garrison.

In 1865 a project was adopted providing for inclosing the entire island by a masonry wall, to be built at or near low-water line, in order to prevent the lodging of such refuse matter.

Under an allotment made in 1865, 700 linear feet of masonry wall was built on the southwest side of the island in 1866, and under other smaller allotments 399 linear feet, as reported, was built. This would make a total of 1,099 feet, which, however, exceeds the present length, by actual measurements, by about 350 feet. This was subsequently extended as a temporary dry wall nearly along high-water line to Castle Williams, covering the entire southwest side of the island.

By act approved August 7, 1882, $39,000 was appropriated "for completing a sea wall already commenced on the southwest side of Governors Island, New York Harbor, and constructing a sea wall on its

southeastern portion." Under this appropriation and one of $15,000, made in the sundry civil bill approved March 3, 1883, the wall was extended 206 feet along the south side of the island and 1,502½ feet along the east side to the coal wharves. In 1884 an allotment of $500 was made for completing the filling and grading behind the east wall, left unfinished on account of the exhaustion of funds.

From the coal wharf to the permanent stone wharf, a distance of about 325 feet, the island is inclosed by wharf fronts and timber bulkheads. On account of the protection afforded by these structures this portion of the island has not heretofore been included in the project for inclosing the entire island by a masonry wall. These wooden structures are decayed and rapidly deteriorating, and should be replaced by a permanent stone wall.

From the permanent stone wharf to within 1,099 feet of Castle Williams wall the island is inclosed by the ordnance wall. Under the appropriation of September 22, 1888, $50,000 was appropriated for the construction of a wall about 1,100 feet long on the north side of the island, between the ordnance wall and the Castle Williams wall. This wall, 1,099 feet long, was completed April 4, 1890. Filling the space back of this wall with earth embankment was in progress at the beginning of the present fiscal year under a contract with Michael Donnelly, of Brooklyn, 21,497 cubic yards of earth and miscellaneous filling having been delivered in the work to June 30, 1890. Thus on July 1, 1890, the entire island was inclosed by a masonry wall with the exception of about 1,500 feet on the west side of the island, which was a part of the original project, and about 325 feet on the east side of the island at the coal wharf, which has not heretofore been included in the project for inclosing the island with a sea wall.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

Under the contract with Michael Donnelly, dated May 31, 1889, which was in force at the beginning of the year, 1,153 cubic yards of filling was delivered in the work, during July and August. The contractor then abandoned the work, and his contract was annulled by authority of the Chief of Engineers, dated October 21, 1890. About 2,000 cubic yards of earth was required to complete the filling back of the sea wall on the north side of the island at the time the work was abandoned by the contractor. Provision was made for completing this filling in connection with the construction of the sea wall and embankment on the west side of the island.

In the appropriation for preservation and repair of fortifications, approved August 18, 1890, was an item "for completing sea wall on Governors Island, New York harbor, $50,000." After duly advertising, proposals were opened October 31, 1890, and a contract, dated November 26, 1890, was entered into with Breuchand, Pennell & Co., of Yonkers, N. Y., to construct a masonry wall on a concrete foundation, on the west side of the island, to connect the Castle Williams sea wall with the sea wall on the south side of the island, a distance of about 1,515 feet, and for placing about 41,000 cubic yards of embankment back of this wall, and the 2,000 cubic yards of embankment back of the wall on the northwest side of the island required to complete the filling there. The prices for work under the contract with Breuchand, Pennell & Co. were $11 per cubic yard for concrete foundation, $19 per linear foot of masonry wall, and 29 cents per cubic yard for embankment. Preliminary work under this contract, including the con-

struction of tool houses, quarters for workmen, and a pile dock 320 feet long, was begun as early in the spring as the weather would permit. The construction of the sea wall was commenced May 1, and is now in progress.

To June 30, 1891, 144.05 cubic yards of concrete foundation was put in, of which 16.41 cubic yards was at the north end, and 127.64 cubic yards at the south end of the new wall. One hundred and fifty-three and fifty-nine one hundredths linear feet of masonry wall has been built, all of which is at the south end. Work on the embankment has not been begun.

Present condition of the sea walls around the entire island:

For 1,023 feet west of the permanent stone wharf the island is inclosed by the ordnance wall. This wall needs repointing, the mortar being washed out of most of the joints to a depth of from 2 to 12 inches, endangering the stone work. With this exception the ordnance wall is in good condition. Estimated cost of repointing 1,023 feet of wall is about $1,100.

The next 1,099 feet is covered by the sea wall on the north side of the island completed April 4, 1890. This wall and foundation are in good condition. About 2,000 cubic yards of earth embankment is required to complete the filling back of this wall. This work is provided for in connection with the construction of the sea wall on the west side of the island. A balance of $3,740.98 is available for completing this work from the appropriation of $50,000 made September 22, 1888.

The next 368 feet of the shore of the island is covered by the Castle Williams wall. This wall bears date of 1812, and was probably built in that year. The wall is in good condition.

The next 1,515 feet along the west side of the island is to be inclosed by the wall now being built under the contract with Breuchand, Pennell & Co.

From this point along the south, southeasterly, and easterly sides of the island, about 2,300 feet to the coal wharf, the wall is in good condition.

The remaining distance around the island, about 325 feet to the permanent stone wharf, is covered by wharves, buildings, and timber bulkheads, which are in a dilapidated condition. As this portion of the island will in the future, as in the past, be used for wharves and landings, the foundations of the wall should extend to a depth which would permit dredging in front of the wall without danger of undermining it. This will materially increase the cost of the wall. The estimated cost of building this 325 feet of wall is $17,000.

Money statement.

July 1, 1890, balance unexpended		$8,757.10
Amount appropriated by act approved August 18, 1890		50,000.00
		58,757.10
June 30, 1891, amount expended during fiscal year		5,016.12
July 1, 1891, balance unexpended		53,740.98
July 1, 1891, outstanding liabilities	$2,608.44	
July 1, 1891, amount covered by uncompleted contracts	47,446.76	
		50,055.20
July 1, 1891, balance available		3,685.78
Amount (estimated) required for completion of project, submitted June 30, 1891		17,000.00
Amount that can be profitably expended in fiscal year ending June 30,1893		17,000.00

Abstract of proposals for construction of a sea wall on Governors Island, New York Harbor, opened October 31, 1890, by Col. D. C. Houston, Corps of Engineers, U. S. Army.

No. of proposal.	Name and address of bidder.	Price per cubic yard for foundation (1,000 cubic yards).	Price per linear foot for wall above foundation (1,510 linear feet).	Price per cubic yard for filling behind both walls (43,000 cubic yards).	Price per pound for iron cramps and dowels.	Date when work will be completed.	Amount of bid for wall.	Amount of bid for filling.	Total amount of bid for wall and filling.	Remarks.
				Cents.	*Cents.*					
1	Martin Hendricks, Washington, D. C	$7.38	$36.00 24.77	.....	22	Nov. 1, 1891	$61,740.00 44,782.70	.....	.....	Granite. Sandy Hill.
2	Hiram W. Phillips, Quincy, Mass., and Frank Scripture, Rockport, Mass.	23.00	29.00 25.00	.....	12	10 months...	66,790.00 60,750.00	.....	.....	Granite. Stone similar to that used in last wall.
3	Michael Finn and Thomas Hayden, New York City.	16.00	63.00	40	10	30 months...	111,130.00	$17,200	$128,330.00	Stony Creek, Conn., granite.
4	Francis H. Smith, New York City	15.75	22.25	28	25	During 1891.	49,347.50	12,040	61,387,50	Stone similar to that used in last wall.
*5	Breuchand, Pennell & Co., Yonkers, N. Y.	11.00	19.00	29	23	6 months....	39,690.00	12,470	52,160.00	Blue dolomite (*lowest bid*).
6	George F. Doak, New York City	11.25	21.90	29	10	Oct. 31, 1891	44,319.00	12,470	56,789.00	Blue dolomite.
7	Stephen A. Kelly, Brooklyn, N. Y.....	13.00	19.25	43	17	Nov. 30, 1891	42,067.50	18,490	60,557.50	Hard, durable stone.

* Entered into contract November 26, 1890.

Abstract of contracts for sea wall and embankment at Governors Island, New York Harbor, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date of contract.	Subject of contract.	Price.	Remarks.
Michael Donnelly, Brooklyn, N. Y.	May 31, 1889	Delivering and placing filling.	Filling in place, per cubic yard, 22½ cents.	Contract annulled October 21, 1890.
Breuchand, Pennell & Co., Yonkers, N. Y.	Nov. 26, 1890	Construction of sea wall and embankment.	Concrete foundation in place, per cubic yard, $11. Masonry wall, per linear foot, $19. Embankment, per cubic yard, 29 cents. Cramps and dowels, per pound, 25 cents.	Contract not yet completed.

APPENDIX No. 3.

BEACH PROTECTION, WATER SUPPLY, AND SEWERAGE SYSTEM AT FORT MONROE, VIRGINIA.

REPORT OF LIEUTENANT-COLONEL PETER C. HAINS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR FISCAL YEAR ENDING JUNE 30, 1891.

IMPROVEMENTS.

a Beach protection at Fort Monroe, Virginia.
b Water supply at Fort Monroe, Virginia.
c Sewerage system at Fort Monroe, Virginia.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 10, 1891.

GENERAL: I have the honor to forward herewith my annual report for the year ending June 30, 1891, on fortifications in my charge.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

3 A.

BEACH PROTECTION.

The beach on the bay side and to the northeastward of Fort Monroe is being eroded by tidal currents, and especially by northeast storms. This action has progressed to such an extent that the narrow strip of beach which connects Fort Monroe with the mainland, and which has been selected as sites for new batteries, is in danger of being cut through. This narrow strip of land, besides affording communication with the cemetery, is the only area of ground belonging to the reservation not occupied by buildings, and its preservation is essential for military purposes. An allotment of funds from the appropriation for preservation and repair of fortifications, enabled the construction of jetties to be commenced, and an appropriation of $27,000 having been subse-

quently made for this purpose by act of February 24, 1891, a system of beach protection has been commenced. Under date of March 4, 1891, a contract was made with F. J. Kelly for the construction of about 1,600 linear feet of pile jetty, and the work is now in progress, though from lack of efficient management it has not advanced as rapidly as desired. The work of beach protection has not yet reached a sufficiently advanced stage to determine just what the result will be, but from indications already observed, it is expected that not only will the process of erosion be checked, but that accretions may result as the jetty construction progresses.

Money statement.

Amount appropriated by act approved February 24, 1891		$27,000.00
June 30, 1891, amount expended during fiscal year		3,014.40
June 1, 1891, balance unexpended		23,985.60
July 1, 1891, outstanding liabilities	$2,453.62	
July 1, 1891, amount covered by uncompleted contracts	13,365.00	
		15,818.62
July 1, 1891, balance available		8,166.98

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3 B.

WATER SUPPLY.

In my last annual report the necessity for an improvement in the water supply at Fort Monroe was referred to. The supply of good drinking water is dependent on rain water stored in cisterns. This supply is sufficient for drinking purposes only, in consequence of which an expensive system of bringing water in iron pipes from across Mill Creek is maintained. The water obtained in the latter manner is from driven wells, and is of inferior quality. The importance of an adequate supply of good water within the limits of the fortification, and not liable to be cut off, is self-evident. In my last annual report I recommended an appropriation of $10,000 for the purpose of sinking an artesian well as an experiment. It would be money well expended, whether water be found or not, but if a good supply of palatable water be found at no greater depth than 2,500 feet, it would be of great value to the entire community in that section, as well as to the Government. Six thousand dollars was appropriated by act of February 24, 1891. The subject has received careful consideration and investigation during the past year, but the amount made available by the appropriation of February 24, 1891, is not sufficient for the purpose. It is known that a good supply of water can not be had within about 960 feet of the surface, as a well was carried to that depth some years ago, without success. It is probable that the above depth would have to be exceeded by several hundred feet. As $6,000 would not at present cover the cost of sinking a well beyond a depth already demonstrated to be insufficient, the work has not been undertaken. I recommend that an additional appropriation of $4,000 be made.

Money statement.

Amount appropriated by act approved February 24, 1891	$6,000.00
July 1, 1891, balance unexpended	6,000.00
July 1, 1891, balance available	6,000.00

3 C.

SEWERAGE SYSTEM.

No work has been done on the new sewerage system during the fiscal year 1891. Congress, by act approved March 2, 1889, made an appropriation of $25,000 for a sewerage system, *complete*, but, as stated in my report for 1890, that amount was insufficient for the work. A considerable portion of the reservation is occupied by hotels and private buildings for which no satisfactory sewerage system exists, and the owners of these buildings have now been directed by the Secretary of War to submit plans for a system of sewers for that part of the reservation outside the fort, and with which the post sewers could be connected. Such plans were submitted in February, 1891, and, with a few exceptions, were unobjectionable. No progress has yet been made toward carrying the plans into execution.

Money statement.

July 1, 1890, balance unexpended	$24,902.10
July 1,1891, balance unexpended	24,902.10
July 1, 1891, balance available	24,902.10

APPENDIX NO. 4.

REPAIR AND PRESERVATION OF FORT MARION, ST. AUGUSTINE, FLORIDA.

REPORT OF CAPTAIN WILLIAM M. BLACK, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR FISCAL YEAR ENDING JUNE 30, 1891.

UNITED STATES ENGINEER OFFICE,
St. Augustine, Fla., July 10, 1891.

GENERAL: I have the honor to transmit herewith my annual report for 1891, on the defenses of * * * St. Augustine, Florida.

Very respectfully your obedient servant,

W. M. BLACK,
Captain, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPAIR AND PRESERVATION OF FORT MARION.

Fort Marion, St. Augustine, Fla., was built during the Spanish possession. It was at first named Fort San Augustin, and later Fort San Marcos.

In the act approved July 5, 1884, $5,000 was appropriated for the preservation of the fort and the inclosure of its grounds. With this appropriation a picket fence was built along a portion of the reservation boundary line; the sea wall and covered way breast-height walls repaired; two bastion towers renewed; the interior walls refaced where necessary; the ramp rebuilt, and a portion of the terreplein covered with a waterproof pavement for the protection of the casemates. In all of the repairs the original designs were followed as closely as possible.

Under allotments from the appropriation for "preservation and repair of fortifications," the following repairs to the permanent work were made, viz: A short length of the sea wall at the north end of the fort and the north end of the water battery, which had been partly undermined by wave and current action, were protected; the sally port, the terreplein of the southwest bastion, and about two-thirds of the terreplein of the south curtain were covered with a waterproof pavement; a concrete drain was constructed under the sally port; the two sentry towers on the south face were repaired; a portion of the inner parapet wall of the east curtain was rebuilt; the two bridges leading to the fort were rebuilt, and a new floor was laid in casemate No. 4.

In the act of August 18, 1890, $15,000 was appropriated for this fort. Work under this appropriation was done by hired labor, using materials purchased by contract. It was begun on October 20, 1890, and continued to the close of the fiscal year, when the following work had been accomplished:

An accurate topographical survey of the reservation was made and the notes plotted.

One thousand nine hundred and fifty-four and four-tenths square yards of 2½-inch waterproof concrete pavement was laid, completing the covering of the terreplein.

One hundred and forty-six and seven-tenths squares of brick pavement on the terreplein was repointed, numerous broken portions having been previously relaid.

Fifty linear feet of the banquette tread and four embrasures were repaired.

Twenty-nine concrete spouts, 2½ feet in length, were put in to carry off rain water from the terreplein.

The staircase on the outside of the northeast watchtower was removed and set up inside the tower. Ten wooden benches for the use of visitors were placed on the terreplein.

Window frames and sashes were removed from forty-four casemate windows and their places supplied by iron gratings.

Five door facings and forty-four window facings were repaired with concrete, and one new door was put in.

The ditch around the fort was cleaned out and graded.

Three short retaining walls of concrete, containing 28 cubic yards, were built near the entrance.

The quarters occupied by the ordnance sergeant were removed from the covered way of the ravelin to a vacant Government lot on the west side of the reservation.

Five flights of concrete steps, containing 7.1 cubic yards, were made. The glacis planes were restored to their original condition, and all low places on the reservation were filled and graded. To make this fill 11,517 cubic yards of material (measured in place) was moved an average distance of 1,032 feet, at a cost per cubic yard of 25¼ cents.

The covered way, the slopes of the glacis planes, and all portions of the reservation which had been graded (8.8 acres in all) were plowed, fertilized, harrowed, and planted out in grass.

One thousand one hundred and forty-seven linear feet of new picket fence was built along the south and west portions of the reservation, and 1,930 linear feet of picket fencing was painted.

A concrete sea wall 292.5 feet long, with a return wall of concrete 50 feet long, containing in all 353.5 cubic yards of concrete, 314.8 cubic yards *en masse* and 38.7 cubic yards in blocks, was built along the north boundary of the reservation, at an average cost for concrete *en masse* of $6.82 per cubic yard, including superintendence and tools.

Two concrete drains, each 20 feet long and 8 inches by 8 inches in the clear, were made.

Two hundred square yards of concrete paths, 4 feet wide and 4 inches thick, and 1,269 square yards of concrete paths, 3 feet wide and 3 inches thick, were laid.

Twenty-one cedar and 14 myrtle trees were planted out by hired labor, and 55 palmettos, 40 cedars, 24 oleanders, 15 myrtles, 103 casinos, and 470 Spanish bayonets by contract.

The building of the new sea wall and the filling of the low space behind it has reclaimed a piece of land 62 by 268 feet, worth at least, at

current prices here, $4,000, while the total cost of the wall and filling was about $2,700.

In order to complete the work of restoration of the fort and of improvement of the grounds, the flimsy modern doors of the casemates should be replaced by doors similar to that in casemate No. 7; a neat spiral iron staircase should be placed in the watchtower; the restoration of the chapel doorway should be completed; the drawbridge at the entrance should be restored; the wooden picket fence around the reservation should be replaced by a concrete wall; 2,460 linear feet additional of concrete walks should be built; neat iron benches should be placed at intervals on the grounds, and additional shrubbery should be set out. If the trespassers on the north boundary of the reservation are removed, the sea wall will have to be extended and a slight additional fill made. The total estimated cost of these improvements is $6,500. None of these items, excepting the restoration of the chapel doorway, was included in former estimates. The desirability of these improvements developed as the work first laid out progressed. It is proposed to make a partial restoration of the chapel door with the funds now available, but the design as shown on the blue print of the original drawing, dated 1785, is too elaborate to be reproduced entirely.

Popular interest in this work continues unabated as is shown by the number of visitors during the past year, estimated at 40,000.

The work of the past year has been under the immediate direction of Lieut. D. D. Gaillard, Corps of Engineers, and it is largely due to his energy and good management that the amount of work done with the appropriation has been so great.

The remainder in hand will be expended in accordance with the approved project.

Money statement.

Amount appropriated by act approved August 18, 1890	$15,000.00
June 30, 1891, amount expended during fiscal year	13,782.00
July 1, 1891, balance unexpended	1,218.00
July 1, 1891, outstanding liabilities	575.84
July 1, 1891, balance available	642.16
Amount (estimated) required for completion of existing project	6,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	6,500.00

APPENDIX NO. 5.

POST OF WILLETS POINT, NEW YORK; UNITED STATES ENGINEER SCHOOL; BATTALION OF ENGINEERS; ENGINEER DEPOT.

REPORT OF LIEUTENANT-COLONEL W. R. KING, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1891.

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, July 24, 1891.

GENERAL: I have the honor to submit herewith the following annual report, in duplicate, on the post of Willets Point, New York Harbor; the United States Engineer School, the Battalion of Engineers, and the Engineer Depot.

Very respectfully, your obedient servant,

W. R. KING,
Lieutenant-Colonel of Engineers, Commanding.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

1.—POST OF WILLETS POINT.

At the close of the fiscal year the garrison consisted of 27 commissioned officers and 333 enlisted men, including the following general staff, artillery, cavalry, and infantry officers:

Maj. Clarence Ewen, surgeon, U. S. Army.
Capt. Henry S. Kilbourne, assistant surgeon, U. S. Army.
Capt. Quincy O'M. Gillmore, Eighth Cavalry.
First Lieut. Charles H. Cochran, Seventh Infantry.
First Lieut. Samson L. Faison, Thirteenth Infantry.
Second Lieut. Herbert S. Whipple, Tenth Cavalry.
Second Lieut. Walter H. Gordon, Twelfth Infantry.
Second Lieut. James H. Frier, Seventeenth Infantry.
Second Lieut. Herman Hall, Fourth Infantry.
Second Lieut. Alfred M. Hunter, Fourth Artillery.

The following-named officers were relieved from duty at this post (instruction in submarine mining) on the dates set opposite their respective names, viz:

Class 1889–90.

First Lieut. Adam Slaker, First Artillery, August 31, 1890.
First Lieut. Edgar W. Howe, Seventeenth Infantry, October 7, 1890.
First Lieut. John H. Beacom, Third Infantry, October 1, 1890.
First Lieut. Victor E. Stottler, Tenth Infantry, October 7, 1890.
Second Lieut. Frank L. Winn, First Infantry, August 10, 1890.
Second Lieut. Richard C. Croxton, Fifth Infantry, October 1, 1890.
Second Lieut. George F. Landers, Fourth Artillery, July 31, 1890.
Second Lieut. Henry E. Wilkins, Second Infantry, August 31, 1890.
Second Lieut. Samuel Seay, jr., Twenty-first Infantry, October 1, 1890.

One artillery officer, 1 cavalry officer and 6 infantry officers were assigned to duty at this post in Special Orders, No. 260, Headquarters of the Army, Adjutant General's Office, Washington, November 6, 1890, and one cavalry officer was assigned in Special Orders, No. 280, Headquarters of the Army, Adjutant General's Office, Washington, December 1, 1890.

Second Lieut. William K. Jones, Fourteenth Infantry, was, upon his own application, relieved from duty at this post on June 15, 1891, as per Special Orders, No. 124, Headquarters of the Army, Adjutant-General's Office, Washington, June 7, 1891.

Of the many improvements needed at this post some have been completed during the year, while others from various causes are still delayed.

I. The new building for engineer models has been completed and the models are being cleaned up and arranged in proper order for exhibition. It is proposed to have in this building all the models that were in the old museum, and in addition standard tools and implements of all kinds that are used by engineer troops in surveys, siege operations, pontoniering, and torpedo service.

The entire building, excepting the tin roof, has been built by engineer soldiers, and is a very creditable piece of work. The main building is 28 feet by 84 feet, and the wing 28 feet square, the whole being two stories high and built of brick, with stone quoins and trimmings. The entire cost, including steam-heating plant, was $8,000.

II. The coal shed, built by the Quartermaster's Department, has also been completed, and was used during the past season.

III. An allotment of $9,000 was made for a new guard house by the Quartermaster's Department, but, on opening bids for the building on the plans furnished, it was found that they were all in excess of the amount allotted. New plans have been prepared and forwarded, and it is hoped that during the present year the new guard house will be built.

IV. It has also been found impracticable to get the work of clearing out the ditch completed, although an allotment of $1,200 was made for the purpose. The bids received in response to circulars were found to be excessive, and, although reasonable offers were made as open market proposals, they were not accepted by the Quartermaster's Department, and therefore nothing has been done.

V. The ice pond has also remained unimproved for want of a small amount of funds ($900) estimated for in my last annual report. By walling in and grading around this pond, so as to keep out surface water and get rid of a marshy border on the north side, the quality of the ice could be greatly improved and the sanitary condition of the immediate locality would be benefited.

VI. New plans have been made for the proposed quartermaster and commissary storehouse near the wharf, but no funds have thus far been allotted for the purpose.

VII. Plans were made for lighting the post by electricity and forwarded to the Quartermaster-General in March, 1890, and if that method of lighting is not approved I would respectfully recommend that a small plant be erected for lighting the post by gas. Either of these plans would be more in keeping with modern ideas than the present method of lighting by coal oil.

VIII. The new barracks and mess building are also still unprovided for. The necessity of these buildings has been so often reported, not only by myself but by the post surgeon, and in fact by all officers who have had occasion to investigate the matter, that no further statement of the case seems necessary.

IX. An allotment of $1,692.67 has recently been made by the Quartermaster's Department for a building to contain the fire engines and other appliances for extinguishing fires, and this building will be erected during the present year.

X. I would respectfully renew my recommendation of last year, that a new set of captains' quarters be built, so as to vacate one set now occupied by a captain for two unmarried officers.

XI. A scow load of broken stone and screenings was procured by the Quartermaster's Department, and most of the coarser material has been placed upon the roads, while the finer has been reserved for sidewalks and binding material for repairing the carriageways. The sidewalk has been extended from near the officers' mess to the guard house, and a quantity of brick supplied by the Quartermaster's Department will be used in completing the extension in front of the officers' mess.

XII. A new map of the post has been compiled by first-class Private Tschappat, showing the location, dimensions, and purposes of all buildings, and a copy of this map* is herewith forwarded.

II.—UNITED STATES ENGINEER SCHOOL.

The scope and object of the school have been fully set forth in previous reports, and in the order establishing it on its own present basis; the orders issued in pursuance of the latter, arranging the details of the season's work, are appended, marked A,† B, C.

During the past year a class of three engineer officers completed the full course of three years, and one officer of the artillery and seven officers of infantry completed their course of torpedo instruction.

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The library of the school is under the immediate charge of the battalion adjutant, *ex officio* secretary of the academic staff, and has received many valuable additions during the year in the way of standard scientific works and periodicals.

The appropriation asked for to keep the library up to the proper standard during the next fiscal year is $500, which is respectfully recommended.

A suitable form for a certificate of proficiency at the engineer school has been designed by First Lieut. James G. Warren, Corps of Engineers, post adjutant, and a drawing of it by First Class Private O. Tschappat, company C, Battalion of Engineers, was forwarded to the Chief of Engineers, U. S. Army, on February 25, 1891, and is now being engraved at the Treasury Department.

A new edition of the standing orders of the post and school was prepared by First Lieut. James G. Warren, Corps of Engineers, on October 8, 1890, since which time no essential modification of them has been found necessary, and it is believed that very few additional orders of a general nature will be required for some time to come.

In accordance with my recommendation, the official title of the school was changed to "United States Engineer School," by authority of the Acting Secretary of War, as per letter dated Office of the Chief Engineer, U. S. Army, Washington, D. C., September 24, 1890.

In accordance with a long-contemplated plan, arrangements were made during the past winter for a few lectures on professional subjects, and now that a suitable room is available it is hoped that a regular course of lectures may be held during the coming winter, to supplement the ordinary course of instruction.

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* Omitted.

† Omitted, as it differs from C in dates only.

The following lectures were delivered: "Improvement of Tidal Rivers," Maj. C. W. Raymond. "Foundations under Difficulties," Mr. John Anderson. "English Engineering in Egypt," Dr. R. W. Raymond. "Concrete Breakwaters," Capt. F. A. Mahan.

It is thought that many officers of the Corps of Engineers, who have had special or difficult engineering work in charge, could with very little inconvenience to themselves do a great deal of good in disseminating the information obtained by them from experience, sometimes costly to the Government, as well as onerous to themselves, among the younger officers of the Corps, and thus supply a kind of knowledge not to be obtained from text-books, but of the greatest value to the service.

III.—BATTALION OF ENGINEERS.

The law provides for five companies of engineer troops, having an aggregate strength of 752 enlisted men, officered by detail from the Corps of Engineers. At present only four companies, with a total strength of 500 enlisted men, are allowed to be recruited.

The aggregate strength of the battalion on June 30, 1891, including Company E, stationed at West Point, was 20 commissioned officers and 417 enlisted men.

During the year Companies A, B, and C have been stationed at Willets Point. Company D exists in name only. Company E has been stationed at West Point, to assist in the practical instruction of cadets of the Military Academy, in building military bridges, sapping, mining, and signaling.

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Second Lieut. Henry Jervey, Corps of Engineers, was relieved from duty with Company B and appointed quartermaster, Battalion of Engineers, April 4, 1891, as authorized by letter from the Acting Secretary of War, dated War Department, Adjutant-General's Office, Washington, D. C., April 2, 1891.

First Lieut. Eugene W. VanC. Lucas, Corps of Engineers, on temporary duty with Company E, Battalion of Engineers, since November 1, 1890, as per Special Orders No. 250, Headquarters Army, Adjutant-General's Office, Washington, October 25, 1890. Relieved from duty at the U. S. Engineer School and assigned to duty with Company E, Battalion of Engineers, in Special Orders No. 57, Headquarters Army, Adjutant-General's Office, Washington, March 13, 1891.

Second Lieut. Charles H. McKinstry, Corps of Engineers, was relieved from duty at the U. S. Engineer School, post of Willets Point, and assigned to duty with Company E, Battalion of Engineers, in Special Orders No. 66, Headquarters Army, Adjutant-General's Office, Washington, March 24, 1891.

The following table shows the changes that have taken place in the personnel of the officers during the year, viz:

Rank.	Name.	Date.	Relieved or joined.	Remarks.
Additional Second Lieutenant.	Keller, Charles	Sept. 30, 1890	Joined	S. O. 222, A. G. O., Sept. 22, 1890.
Do.....	Deakyne, Herbert ..	....do	....do	Do.
Do.....	Bromwell, Charles S.	....do	....do	Do.
Do.....	Jadwin, Edgar	Feb. 13, 1891	....do	S. O. 32, A. G. O., Feb. 9, 1891.
Second Lieutenant.....	Judson, William V..	Apr. 4, 1891	Relieved	S. O. 66, A. G. O., Mar. 24, 1891.
First Lieutenant	Zinn, George A.....	....do	....do	Do.
Do.....	Biddle, John.....	....do	....do	Do.

RECRUITING, DISCIPLINE, ETC.

During the year recruits for the battalion have been obtained by enlistment at Willets Point and West Point, and by assigment on their own application from recruiting rendezvous or other branches of the service.

No special representative of the battalion has been on duty at the rendezvous in New York or elsewhere during the year, and as a consequence the enlisted strength of the battalion has fallen off somewhat, though it is still larger than at any other time during the past seven years, excepting last year.

There are now fully as many men in the companies here as can be comfortably quartered in the old barracks, and it was found that when the number in each company was increased to about 130 men, there was uncomfortable crowding, which undoubtedly produced an unfavorable effect upon the health and discipline of the command.

The following is a statement of changes among the enlisted men of the battalion during the past year :

Gain :	
Recruits from depot	11
Enlisted (at West Point, 31; at Willets Point, 19)	50
Reënlisted (at West Point, 10 ; at Willets Point, 49 ; Engineer Battalion, 41 ; other arms of service, 18)	59
By transfer (upon their own application)	5
From desertion	5
Total gain	130
Loss :	
Discharged by expiration of service	60
Discharged for disability	9
Discharged by order (special)	12
Discharged by order (General Orders No. 80, A. G. O., series of '90)	12
Discharged by order (General Orders No. 81, A. G. O., series of '90)	8
Transferred (ill health, 1 ; hospital corps, 4 ; other causes, 27)	32
Retired	11
Died	1
Deserted (Co. A, 7 ; Co. B, 1 ; Co. C, 6 ; Co. E, 1)	15
Total loss	160

The following table gives a comparative statement of recruiting, desertions, etc., during the past seven years :

Fiscal year.	No. of men on June 30.	Recruiting.		Average daily number.		Desertions.	Trials.		
		Enlisted.	Reënlisted.	Arrest or confinement.	Sick.		General court-martials.	Garrison court-martials.	Summary courts.
June 30, 1884, to June 30, 1885.	383	56	30	6	18	106	11	59	.....
June 30, 1885, to June 30, 1886.	396	57	38	8	22	76	20	107	.....
June 30, 1886, to June 30, 1887.	388	20	28	9	17	49	19	160	.....
June 30, 1887, to June 30, 1888.	387	9	24	12	22	49	21	218	.....
June 30, 1888, to June 30, 1889.	402	90	29	6	20	23	4	214	.....
June 30, 1889, to June 30, 1890.	468	147	64	9	14	52	13	304	.....
June 30, 1890, to June 30, 1891.	417	50	59	6	12	15	12	60	138

NOTE: The figures for 1888, 1889, 1890, and 1891 include the post noncommissioned staff and hospital corps at this post.

This table shows that the enlisted strength of the battalion is greater than at any previous time excepting last year; that the number of en-

listments has been about the average, while the number of reënlistments has been much greater than the average during the past 7 years. The number of men sick and the number in confinement have both been below the average, while the number of desertions has not only been smaller than in any previous year, but *less than one-third of the average number.*

The number of court-martial cases has also diminished to about two-thirds of last year's number. This last reduction is largely due to the wholesome effect of the "summary court." It is seldom that a new law or regulation proves so uniformly beneficial from the start, and with some slight changes in the wording of the law it is believed that it will fully satisfy all the requirements for securing a speedy and impartial trial and substantial justice *to the service* as well as the evil doer.

The success of this experiment should lead to the substitution of garrison courts for general courts for the trial of all cases now triable only by the latter, unless the accused demands or appeals to a general court. This would be a perfectly analogous improvement, and would doubtless prove equally advantageous to the service. The average number of men in the guardhouse at the post has been largely increased by the delays caused in disposing of cases tried by general courts. In some instances the prisoners have been kept in confinement for over 4 months, in one case 18 weeks, most of which time was taken up by delays in appointing the courts and reviewing their proceedings. When such cases result in acquittal, as they sometimes do, it is doubtful whether our most inefficient civil courts often present more glaring cases of justice deferred.

The following statement shows the number of different men tried and other facts relative to the trials:

	Trials.
By general court	12
By garrison court	60
By summary court	138
Total	210

	No. of men.	No. of trials.
Tried once	59	59
Tried twice	21	42
Tried three times	13	39
Tried four times	5	20
Tried five times	5	25
Tried six times	3	18
Tried seven times	1	7
Total	107	210

Number of men who pleaded guilty	183
Number of men who pleaded not guilty	27
Total	210
Number of acquittals	11
Number found guilty	199
Total	216

The battalion has lost during the year fifteen men by retirement, mostly under the law allowing double time for war service. Many of these men are entitled to credit for faithful and meritorious as well as long service, and whenever opportunity has offered, they have been

assisted in procuring profitable employment on the various engineering works in the vicinity, or in private manufacturing establishments. A complete list of all soldiers of the battalion who have been honorably discharged or retired within the past 15 or 20 years, and whose present addresses are known, has been prepared by Sergeant Major Martin, and it is proposed to keep this list corrected up to date, if practicable, so that officers who wish to employ any of these men can ascertain their whereabouts and availability for any particular work.

The combined mess for the three companies and band at this post has been in successful operation during the year, and since the new coffee urns, hot table, and other cooking appliances and improvements, suggested by Major Spurgin, have been in use, there has been little cause for complaint.

The post canteen has also been in successful operation during the year and has contributed $2,638.71 to the mess fund. That the canteen has proved a great success can not be doubted, not only as an antidote to the numerous rum shops in the vicinity, but as a measure of economy. It is hoped that arrangements can be made for employing retired soldiers for at least a portion of the attending force, but at present there are no suitable applicants.

A building suitable for the mess and canteen is very much needed, as explained in former reports.

There was but one death in the command during the year, and notwithstanding the general prevalence of the epidemic known as la grippe, *the number of men admitted to the hospital has been less than at any time during the past 7 years.* This result has, I think, been partially due to the adequate supply of good water and largely to the efficient management of the post surgeon.

The law allowing men a long furlough with the option of a discharge at the end of the 3 years' service is, in my opinion, much less satisfactory in its operation than would be a simple reduction of the term of enlistment to 3 years. It encourages men to leave the service and keeps a large percentage of them away on furlough, without any corresponding advantage to the service, while their places must be kept vacant until they decide whether to go out or continue in service, during which time *their duties must be performed by their comrades.* Not only does it leave the service in a state of uncertainty, but the men themselves are made uneasy and discontented, which did not obtain under the long established rule of a reënlistment within 30 days, followed by a reënlistment furlough.

During the past year there have not been so many cases of absence from the 11 o'clock check roll call as during the previous year, but there is still a large majority of the men who prefer to retire at or before 9:30 p. m., and it is believed that most of those who now remain out of quarters after that time would do likewise if the canteen were closed at that hour. For men who get up at 5:30 a. m., it is believed that 9:30, or at latest 10 p. m., is not too early to retire, and except in case of a few thoughtless or intemperate ones, the men themselves appreciate this fact.

As passes are freely granted to all who need and desire them, all reasonable necessities for keeping late hours are provided for without the trouble and annoyance to those who wish to retire early, that necessarily result from the return to barracks of the few who prefer to keep late hours, and who in some cases retire in a more or less intoxicated condition.

DRILLS AND INSTRUCTION.

During the year the battalion of engineers has been drilled and instructed as follows:

1. Infantry tactics: School of the soldier, company, and battalion.

2. In target practice: The practice season for the post of Willets Point, New York Harbor, for the past year was from August 11 to October 10, 1890, inclusive, as prescribed in General Orders No. 7, Headquarters Corps of Engineers, Washington, August 7, 1890. Authority having been granted by the governor of the State of New York for the free use of the rifle range at Creedmoor for a period of about 60 days, target practice was held at that place. Detachments averaging 2 officers and 60 men, commanded by captains in turn, were encamped at Creedmoor until the score required had been obtained.

In the last target year 1 man qualified as sharpshooter and 41 as marksmen.

In the rifle contest at Fort Niagara 8 prizes of the available 20 were won by the battalion team, as follows:

In the Department of the East match: Number of competitors, 70; average of 12 highest scores, 518.

Corporal Truman Organ, Company E, won first prize, gold medal; score, 547.

First Lieut. Charles L. Potter, Corps of Engineers, won second prize, silver medal; score 545.

Sergeant William A. Boyle, Company C, won third prize, silver medal; score, 536.

Corporal John Kelly, Company A, won fifth prize, bronze medal; score, 523.

In the Division of the Atlantic match: Number of competitors, 34; average of 12 highest scores, 539.

First Sergeant Martin Doolan, Company B, distinguished marksman, made the highest score, 554.

Corporal Truman Organ, Company E, won first prize, gold medal; score, 548.

Corporal John Kelly, Company A, won fourth prize, gold medal; score, 545.

First Lieut. Charles L. Potter, Corps of Engineers, won seventh prize, silver medal; score, 538.

Sergeant William A. Boyle, Company C, won eighth prize, silver medal; score, 538.

Thus, in addition to the winning of first place in the division match by First Sergeant Martin Doolan, Company B, 8 of the 20 available prizes were won by the Engineer Battalion with about one-twentieth ot the number of competitors.

First Sergeant Martin Doolan, Company B, distinguished marksman and representative of the Division of the Atlantic, won seventh prize at Camp Douglas, Wis., in the Army rifle team of 1890. Total score for 4 days 504.

First Lieut. Charles L. Potter, Corps of Engineers; Corporal John Kelly, Company A; Sergeant William A. Boyle, Company C; and Corporal (now sergeant) Truman Organ, Company E, have been transferred to the distinguished class of marksmen for the year 1890, as published in General Orders, No. 112, Headquarters Army, Adjutant General's Office, Washington, October 2, 1890.

These results are especially creditable in view of the limited time and imperfect facilities available for target practice at this post.

3. In pontoniering during the months of October and November.

4. Military engineering: Foot reconoissance, tracing and profiling, preparation of siege material, construction of spar bridges, double lock, including knots and lashings, during the month of November, 1890.

5. Torpedo drills were had throughout the year, the winter months being devoted to indoor drills and practice in the loading room, and the summer months to outdoor drills and exercises.

The following number of men received instruction during the winter months, viz: 17 sergeants, 21 corporals, 224 privates.

Qualifications of privates:

Qualified	206
First class	12
Second class	3
Third class	3
	224

Seventeen men were excused, being already rated as qualified in torpedo service; 8 men were absent on furlough, and 6 men were reported sick during indoor course.

During the summer months 8 grand groups were planted, which required 8 different details by roster; each detail averaging 3 officers, 3 noncommissioned officers, and 13 privates.

6. Photography: Selected details of noncommissioned officers have been instructed in military photography.

The prescribed course was completed by a class of 6 engineer officers in the spring, and their examination on May 6, 1891, has been already reported.

Several line officers have availed themselves of the privilege of instruction at the laboratory, and some engineer officers have continued their practice since the completion of their course.

Eikonogen and hydroquinon, as developers for dry plates and bromide paper, have been constantly used, and amply fulfill what earlier experiments indicated; the use of bromide paper for maps and line work has been extended and gives great satisfactions; some larger apparatus for making blue prints has been made, and a large map of the post successfully reproduced; numerous plates and prints of explosions, models of United States bridge equipage, buildings, and plans have been made in connection with the instruction of officers and enlisted men.

The photolithographic process requires long and constant practice to render one skillful; requires considerable plant; more time and probably more expense, except where the number of reproductions desired is very large, than the process recommended below. As an officer does not acquire the requisite skill, so would probably need a printer to assist him, the time spent in making preparations for a lithographic transfer could in many instances be ill spared. The use of bromide paper would overcome many of these objections. Printing by contact or by projection can be done by artificial light and with sufficient rapidity where 20 or 30 copies are desired; development and fixing require but a short time. The actual cost of each print is greater than a lithographic transfer, but considering the material wasted in the latter, the copies which are imperfect, and the cost of the press, stones, etc., we should probably find 30 bromide prints to cost less than the same number of lithographic transfers.

The wet-plate process is not necessary to an officer, can not be used in field work, and instruction in it necessitates a great expenditure of chemicals.

For bromide printing a light of constant intensity is of great importance. Oil lamps are now used and are not satisfactory in this respect. Three or four incandescent electric lights of 16-candle power, supplied by accumulators, would be an improvement. Their purchase is recommended.

In view of the desirability of having a more distinctive uniform for the Battalion of Engineers, I caused a sample uniform to be prepared by one of the company tailors, in which orange was substituted for scarlet in the facings of the dress coat and the lining of the overcoat cape, and dark-blue for light-blue trousers. This uniform, which was forwarded to the Chief of Engineers in May last, appears to be very much desired by both officers and enlisted men of the battalion, and I respectfully recommend that the proposed change may be authorized.

I would respectfully recommend that the pay of all grades of noncommissioned officers in the Battalion of Engineers be increased, and that the grade of first sergeant be established by law, with a rate of pay proportionate to the responsibility of the office.

In 1846, when engineer troops were first organized, Congress, recognizing that superior intelligence and special qualifications were demanded by this branch of the service, authorized special rates of pay for noncommissioned officers of engineers. Since that date, although the standard of value has changed throughout the country and wages have been advanced in every department of labor to accord therewith, the pay of noncommissioned officers of engineers has been increased but $4 per month. In this respect the line of the Army has been benefited far more. The pay of sergeants of artillery and infantry has been advanced 30.7 per cent., while that of engineer sergeants has been advanced but 13 per cent.; corporals of artillery and infantry have been advanced 66 per cent., while corporals of engineers have been increased but 20 per cent.

The engineer service to-day demands men of superior attainments to that of 45 years ago. The duties are more arduous and exacting. In the use of steamboats, steam-engines, electrical apparatus, high explosives, etc., in addition to their original duties as sappers, miners, and pontoniers, there has arisen a demand for a class of skilled mechanics in the Battalion of Engineers not contemplated or existing at the time the rates of pay for engineer troops were established.

Many cases have occurred within the past few years in which Engineer soldiers have left the battalion to accept employment in civil life at from $75 to $150 per month, and generally this has been done through officers who have discovered the value of these men while serving with them as soldiers.

It is no answer to a man, who is earning three or four times as much as he receives, to tell him he is getting four or five dollars a month more than someone else. I know of no better way to secure a good article than to pay the market price for it, and therefore believe that the interests of the service require a liberal policy in regard to extra pay for skilled service. In this way, the class of men we must have at any price in time of war may be induced to remain and qualify themselves in time of peace, and in no other way can a sufficient number of such men be induced to enter or remain in the service.

The following rates of pay are suggested:

Sergeant-major	$60.00
Quartermaster-sergeant	60.00
First sergeant	50.00
Sergeant	40.00
Corporal	25.00

I would also recommend that one chief musician and two principal musicians be authorized for the Battalion of Engineers, the same as for other regimental organizations.

ENGINEER DEPOT.

PUBLIC BUILDINGS AND CONSTRUCTIONS.

I. The new brick building for Engineer models has been completed and occupied, as already reported. All the work on this building was performed by enlisted men of the Battalion of Engineers, detailed on extra duty. The cost of this labor amounted during the fiscal year to $764.88.

II. Plans and estimates for the new fire-proof storehouse for ponton, siege, and torpedo materials have been completed, and an appropriation of $16,000 having been made at the last session of Congress, work was commenced on the 1st of July of the present fiscal year.

The location of this building is such that it will be convenient for the storage of all the tools and materials formerly stored in the frame building destroyed by fire in May, 1890, and it will also contain large quantities of torpedo materials now stored in old frame buildings near the wharf. The building will be 40 by 120 feet, two stories high, the lower story or basement being for boats, paints, and such other property as need not be especially protected from moisture, while the main story will be made as dry as possible for storage of hardware, instruments, etc.

III. Some further study has been given to the plans and details of a small tug for planting torpedoes, and Mr. J. H. Gielow, a naval architect, has been employed to revise the work. Many of his suggestions have been embodied in the plans for the boat, and they are believed to be satisfactory in all respects. It was expected that the boat would have been built before this time, but other matters delayed the beginning of it until it was too late to get it completed in time for this season's work.

IV. The work of repairing the steam tug *Star*, which was sunk during a severe storm in December last, has been about completed, and she will soon be available for such work as she is fitted for. In many respects she is fully as seaworthy as she was 5 years ago.

V. A quantity of lumber was procured for replacing the worn out and destroyed ponton materials, and the work of fitting up has been done by enlisted men of the Engineer Battalion under direction of Sergeant Kelly. Ten bridge trestles complete, 300 chess, 100 balk, and the necessary rack sticks, lashings, etc., have been completed, and ten of the old ponton boats were thoroughly repaired, calked, and painted. These boats are the identical ones used by the armies in the late war, and they are therefore nearly 30 years old. Some of the timber is still quite sound, but the boats would not answer for actual war service, and they will soon have to be replaced even for purposes of drill. It is proposed to begin by building a few each year until enough have been supplied to answer for drill, and for storage to meet emergencies, though it is not probable that in this country ponton bridges will ever figure as conspicuously in the military operations of the future as they have in the past.

VI. A suitable building for the boiler, engine, and dynamos to be used in the trials of the Sims-Edison electric torpedo, now under contract, has been begun and will be completed some time in July.

The engine and boiler have been procured and properly set up on masonry foundations. The torpedo was inspected at the Edison works at Schenectady, and has since been delivered at Willets Point.

Trials of the torpedo will probably take place early in the month of August of this year.

VII. The new motors for the Fish torpedoes of the old pattern that were not supplied with motors when purchased, several years ago, have not been bought, as the trials of the new form of motor will, if successful, indicate that the new form of motor should be used instead of the old one. The last trials of the Sims torpedo showed that, by the adoption of a better form of motor and cable and increasing the E. M. F. to about 1,200 volts, nearly double the speed could be attained, and it was my intention to procure similar motors for the old pattern of the torpedoes, but that motor required gearing to bring the propeller down to the proper speed, and the motors now to be tried dispense with gearing, which, if successful, will be a great advantage. Hence the purchase of motors has been deferred, pending the results of the coming trials, as before stated.

VIII. The usual work of printing, bookbinding, drafting, photographing, etc., and the general work of keeping property and buildings in a proper state of preservation, has been, with some few exceptions, performed entirely by enlisted men of the Engineer Battalion, detailed for the purpose, at an aggregate cost of $3,370.42.

In connection with the foregoing and in the purchase and storage of the large quantities of torpedo materials ordered, there has been much more than the usual amount of clerical and other work involved.

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DEPOT PROPERTY.

The astronomical, magnetic, meteorological, geodetic, reconnoitering, surveying, and drawing instruments, and electrical appliances and instruments on hand in the depot storehouses, have been properly cared for and were kept in a good state of preservation, and the following additions have been made during the fiscal year by purchase, viz:

Four engineer transits, 1 engineer transit with solar attachment, 5 sextants, 12 binocular field glasses, 3 clinometers, 16 prismatic compasses, 10 odometers, 10 cases drawing instruments, 2 pedometers, 3 German-silver protractors, 5 dozen rubber triangles, 1 proportional dividers, and 23 various small drawing instruments.

Proposals were called for in every case, and bidders were required to present samples of their goods, which were subject to a careful examination before the awards were given out; also upon delivery all instruments delivered were very carefully inspected in regard to their accuracy and manner of construction, and in every case only the best and most perfect makes were accepted.

The total amount paid for the above named instruments is $2,074.72.

The following named instruments have been transferred to officers of the Corps of Engineers and to acting Engineer officers at division and department headquarters, upon requisitions duly authorized by the Chief of Engineers, U. S. Army, viz:

One artificial horizon, 8 engineer transits (R. R.), 4 sextants, 1 chronometer break circuit, 6 cases drawing instruments, 12 binocular field glasses, 26 prismatic compasses, 25 odometers, 1 hand level (reflec ting), 1 pedometer, 1 proportional dividers, 1 aneroid barometer, 3 thermometers, 2 metallic tapes (100 feet), 2 steel tapes (100 feet), 2 steel tapes (50 feet), 2 clinometers, 2 compasses, pocket square, 1 boat compass, 1 circular protractor, 6 level-rods, 4 surveyor's rods, 1 surveyor's chain (100 feet), 1 surveyor's chain (50 feet), 4 sets marking-pins, 4 protractors, 12 rubber triangles, 7 rubber rulers, 1 metallic ruler (5 feet), 1 "T" square (54 inch), 1 scale, 2 pocket rules, 6 drawing pens, 1 three-legged dividers, 1 blue print frame, 3 rolls tide-gauge paper.

A large number of surveying instruments, not included in the above, were frequently issued to surveying parties for reconnoitering the vicinity, for the purpose of instruction.

The following-named instruments have been received in depot from officers on public works and surveys, viz:

Three engineer transits, 2 theodolites, 3 engineer levels, 6 sextants, 1 current meter, 2 hand levels (reflecting) 3 odometers, 2 protractors, 2 compasses, pocket square, 1 compass (prismatic).

The greater part of the above instruments were out of order, and some of them are not worth repairing; it is evident that they have been subject to very long service, and they have been inspected and condemned in accordance with instructions from the Chief of Engineers, U. S. A., contained in indorsement on inspection report of May 19, 1891, together with a lot of other instruments that have accumulated during the past few years and were entirely unserviceable and unfit for repairs.

Most of the repairing of the instruments during the year has been performed by enlisted men of the Battalion of Engineers detailed on extra duty as instrument makers. The cost of extra-duty pay for this work amounted, during the fiscal year, to only $248.75, and the cost of the necessary materials required for the repairing amounted to $81.93, or $330.68 for labor .and materials used for keeping in good order the whole supply of instruments in the depot and repairing those that have been sent here for repairs. The demands for repairing instruments have considerably increased during the last fiscal year, and it is evident that, roughly estimated, if these repairs had been done by outside makers the cost would have exceeded $1,200 for the following-named instruments that were repaired in the depot repair shop:

Six astronomical transits, 11 transits and theodolites, 2 surveyors' levels, 1 self-registering tide gauge, 2 surveyors' chains, 22 odometers, 14 prismatic compasses, 3 box compasses, 4 boat compasses, 3 thermometers, 8 cases drawing instruments, 25 circuit regulators, 4 galvanometers, and a large number of small instruments with more or less repairs; also repairing general tools, implements, typewriters, electrical appliances and apparatus.

There is no doubt that all the repairs made here were well made and satisfactory, as no complaints were heard from any point.

A number of instruments that require special skill to be properly repaired were sent to such makers as make a specialty of each kind of work. The amount paid for repairing such instruments during the fiscal year was only $94.60, about $200 less than during the previous fiscal year. The following have been repaired in this manner, viz:

Eight chronometers, 2 silver watches, 1 astronomical transit, and 1 telescope.

In accordance with circular No. 5, Office of the Chief of Engineers, U. S. A., dated Washington, D. C., June 25, 1889, the following articles of United States engineer property were transferred in the usual manner on duly authorized requisitions, viz:

To Captain Bixby, Corps of Engineers, U. S. A., at Wilmington, N. C., 4 large anchors.

To Major Livermore, Corps of Engineers, U. S. A., for use on works under his charge at Stonington, Conn., 15 large anchors, 10 small anchors, 15 cable chains.

The supply of the articles named in the above circular has become exhausted on account of frequent issues, and owing to the burning of the engineer storehouse, there are now only axes and picks available for issue as surplus.

EXPERIMENTS.

I. *Sims fish torpedo.*—No runs of this torpedo were made at this post, but the new experimental torpedo referred to in last year's report, and which belonged to the Sims-Edison Company, was removed, and preparations are making for testing the new 2-mile torpedo contracted for by the Government.

It is stated that after its removal to Havre, France, the 1-mile boat made a speed of about 24 miles per hour, or about 5 miles more than it made here. This was probably due to the use of a higher electro-motive force and to the fact that the stanchions between the torpedo proper and the float were shortened so that the axis of the torpedo was only about 2 feet below the surface of the water.

II. Tests of explosives were continued and such new compounds as were brought forward by manufacturers were tested. In these tests the use of the Eprouvette, described in last report, was found to give very satisfactory results and made it possible to multiply experiments with great facility so as to get reliable mean results.

The explosives tested during the year were gun cotton, tonite, dynamite No. 1, Columbia powder of several grades, emmensite, and service rifle powder, and the details of the experiments are given by Lieutenants Jervey and Keller, U. S. Engineers, who made the experiments in their reports, which are appended and marked D, and the results are also plotted and shown on plates.*

Since the number of high explosives available for submarine mining operations has become so great, some four or five hundred in all, there is no possible doubt of our ability to procure them in both quantity and quality, that will answer all purposes, and recent inquiries develop the fact that almost any quantity of dynamite No. 1, or its equivalent in other compounds, can be procured in an emergency as fast as it could be used. The facility with which inventors bring out new mixtures and compounds, some of which are prepared over a cooking stove with about the same caution as an ordinary cook would give in broiling a chop, suggests the wisdom of a remark made by one of the most experienced powder manufacturers, viz, "No new explosive compound should be experimented with until it is at least 2 years old."

III. Some further tests were made of the sensitiveness of explosives to percussion in the manner described in last report. These tests were applied only to a few new compounds to enable the inventor to decide as to the relative advantage of certain changes in the proportion of ingredients.

IV. For the purpose of obtaining practice in the location of mortar projectiles by triangulation, as well as to test in a rough way the accuracy of fire at short ranges, some experiments were made by firing a 13-inch mortar with small charges of powder and wooden projectiles, made from the tough butts of elm and apple trees. In this way a range of about half a mile could be attained, and as the projectiles were a little lighter than water they could be picked up and fired over and over again, the only expense involved being a pound or two of powder for each shot. In this way all the benefit of mortar practice could be had, so far as serving and pointing the piece was concerned, and the experience in locating the point of impact of the projectile in the water was precisely the same as it would have been in firing service projectiles, excepting that the range was very much shorter.

The effect of wind was not as great as might have been expected, and by selecting still days it is not a serious difficulty.

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* Omitted.

It is thought that this method of mortar practice, since it would enable a very large number of shots to be fired in a single day, as well as in a season's practice, would be a useful addition to the limited practice now allowed with service projectiles, and the cost of a whole season's firing would be a very trifling amount. The drill and practice in locating the fall of the projectile would, as before stated, be just as valuable as when firing service projectiles.

V. A few tests of building materials were made and the results are shown in the report of Lieutenant D'Armit, U. S. Engineers, appended hereto, marked E.

VI. In order to test certain parts of the torpedo mechanism under something like service conditions, application was made through proper channels to the Navy Department for the use of a war vessel for that purpose, but in reply it was stated that there was none available. On a further application the U. S. S. *Quinnebaug*, from which the engines and part of the shaft had been taken, was procured, and a powerful steam tug was employed to tow her over the mines. Reports of these experiments in detail have been made through the Board of Engineers under whose direction the experiments were made.

VII. Other experiments and tests have been made from time to time for special objects, among which were tests of cut-off boxes, to ascertain the effect of heavy charges of fulminate in causing leakage through the metal and glands, tests of cables to ascertain their fitness for service, measurements in the magnetic field of dynamos with a view to ascertaining the effect of neighboring electrical instruments, tests of various forms of circuit-closer to ascertain their behavior under impact, tests of mooring shackles and methods of loading torpedoes. Some of these experiments have been reported on already and the others will be when the necessary data have been obtained.

VIII. A number of recent inventions were received from England and placed in the torpedo laboratory. Among these is a complete English service torpedo, two circuit closers, a soluble circuit break for a self-acting mine, and some electromagnetic disconnectors, all of which are different from anything we have had heretofore and are claimed to possess certain advantages.

STATEMENT OF FUNDS.

1. *Engineer depot at Willets Point, New York.*—Congress appropriated for the fiscal year ending June 30, 1891:

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For instruction of battalion (materials)	1,500.00
3. For purchase and repair of instruments (instruments)	2,500.00
4. For purchase and binding of professional works of recent date on military and civil engineering (library)	500.00
5. For a new building to contain engineer models (building for models). Congress appropriated for this purpose under act approved March 2, 1889, $8,000, and under act approved June 13, 1890, this appropriation was extended to June 30, 1891. July 1, 1890, balance unexpended	3,029.63
Total	12,529.63

Of this there has been expended and pledged:

1. For incidental expenses of depot (incidentals)	5,000.00
2. For instruction of battalion (materials)	1,500.00
3. For purchase and repair of instruments (instruments)	2,500.00
4. For purchase and binding of professional works of recent date, on military and civil engineering (library)	500.00
5. For new building for engineer models (building for models)	3,029.63
Total	12,529.63

II. *Torpedoes for harbor defense (act September 22, 1888.*—1. Congress appropriated under act approved September 22, 1888, the sum of $200,000, from which the amount of $98,000 has been assigned to me for disbursement and is available until expended.

July 1, 1890, balance unexpended	$50,140.33
June 30, 1891, amount expended and pledged during fiscal year	32,823.58
July 1, 1891, balance unexpended and available	17,316.75

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III. *Torpedoes for harbor defense (act March 2, 1889).*—1. The act of Congress making appropriations for fortifications, etc., approved March 2, 1889, appropriated, under the general title "Torpedoes for harbor defense," the sum of $250,000 for purchase of submarine mines and necessary appliances and $30,000 for instruction of engineer troops in submarine mining. These amounts were assigned to me for disbursement and are available until expended.

July 1, 1890, balence unexpended	$258,567.23
June 30, 1891, amount expended and pledged during fiscal year	162,078.30
July 1, 1891, balance unexpended and available	96,488.93

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3. From the appropriation for purchase of movable submarine torpedoes the sum of $25,225 was assigned to me for disbursement and is available until expended.

July 1, 1890, balance unexpended	$25,225.00
June 30, 1891, amount expended and pledged during fiscal year	25,225.00

NEW APPROPRIATIONS.

IV. *Torpedoes for harbor defense (act August 18, 1890).*—Until the above act the following appropriation was assigned to me for disbursement and is available until expended, viz:

1. For submarine mines and necessary appliances for storage at Hampton Roads and Portland, Me., and charge bags for Boston, New York, and San Francisco, amount assigned	$100,000.00
June 30, 1891, amount expended and pledged to end of fiscal year	76,243.16
July 1, 1891, balance unexpended and available	23,757.84
2. For continuing torpedo experiments, etc	30,000.00
July 1, 1891, balance unexpended and available	30,000.00

V. *Torpedoes for harbor defense (act February 24, 1891.)*—Under the above act the following allotment was assigned to me for disbursement and is available until expended, viz:

1. For tool boxes, etc., for storage at Willets Point, and for submarine mines, and necessary appliances for storage at Charleston Harbor, S. C., amount assigned	$21,695.00
June 30, 1891, amount expended and pledged to end of fiscal year	4,952.92
July 1, 1891, balance unexpended and available	16,742.08

VI. *Engineer depot at Willets Point, New York.*—General Orders No. 27, headquarters of the Army, Adjutant-General's Office, Washington, March 9, 1891, publish the act of Congress making appropriations for the support of the Army for the fiscal year ending June 30, 1892, and for other purposes.

The following items, from the act approved February 24, 1891, are designated for the engineer depot at Willets Point, N. Y., and assigned to me for disbursement, viz:

1. For incidental expenses of depot (incidentals)	$5,000.00
2. For instruction of battalion (materials)	3,500.00
3. For purchase and repair of instruments (instruments)	2,000.00
4. For purchase and binding of professional works of recent date on military and civil engineering (library)	500.00
5. For a fireproof building to replace engineer depot storehouse destroyed by fire May 10, 1890 (storehouse)	16,000.00
Total	27,000.00

ESTIMATES.

There will be required for the fiscal year ending June 30, 1893, the following for engineer depot at Willets Point, N. Y., viz:

1. For incidental expenses of depot, including fuel, light, chemicals, stationery, hardware, extra-duty pay to soldiers necessarily employed as artificers on work in addition to and not strictly in the line of their military duties, such as carpenters, clerks, draughtsmen, blacksmiths, printers, bookbinders, photographers, lithographers, engine-drivers, teamsters, wheelwrights, masons, machinists, painters, overseers, and laborers, and for materials to repair public buildings, machinery, and unforeseen expenses	$5,000.00
2. For purchase of materials for the instruction of engineer troops at Willets Point, in their special duties of sappers and miners, for land and submarine mines, and pontoniers, torpedo drill, and signaling	3,500.00
3. For purchase and repair of instruments to be issued to officers of the Corps of Engineers and to officers detailed and on duty as acting engineer officers, for use on public works, surveys, and reconnaissances	3,000.00
4. For library of the engineer school: For purchase and binding of professional works of recent date, treating of military and civil engineering and kindred scientific subjects	500.00
Total	12,000.00

Very respectfully, your obedient servant,

W. R. KING,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

APPENDIX B.—PROGRAMME OF STUDY AND INSTRUCTION FOR WINTER SEASON.

[Printed Orders, No. 233.]

UNITED STATES ENGINEER SCHOOL,
Post of Willets Point, New York Harbor, November 19, 1890.

I. The following programme of study and instructions for the ensuing winter season, commencing Monday, December 1, 1890, and ending April 25, 1891 (a period of 21 weeks), having been recommended by the academic staff and approved by the Chief of Engineers, will be carried into effect.

COURSE FOR OFFICERS.

1. Examinations by the academic staff will be held at the end of January and April, and intermediate examinations, as nearly monthly as practicable, will be held by committees of the academic staff. Marks at examinations will be on the West Point system, and the committees will report to the commandant of the school the results of the examinations. As the efficiency of the instruction can be much influenced by the instructors, they will keep themselves fully advised of the progress

of the students; will give them at any time any needed aid, and when the information on special subjects is difficult to obtain, should supplement the course by lectures. The instructors will meet their classes weekly, and assign the lessons for the following week.

FIRST WINTER'S COURSE.

2. The course for engineer officers spending their first winter at the school will be: Electricity and torpedoes, 19 weeks; surveying, 2 weeks. For officers of other arms of the service detailed for special instruction in the torpedo service: Electricity and torpedoes, 21 weeks.

ELECTRICITY.

3. Study of, in its application to torpedo warfare, arc and incandescent lighting, and transmission of power, supplemented by extensive laboratory practice in the solution of the special problems involved. Text-books and books of reference, as follows: Abbot's Notes on Electricity; Ayrton's Practical Electricity; Thompson's Electricity and Magnetism; Maier's Arc and Glow Lamps; Swinburne's Practical Electrical Measurements; Kapp's Electrical Transmission of Energy; Part II of Professional Papers No. 23, Corps of Engineers, U. S. A.; Gray's Absolute Measurements, Volume II; Monroe and Jamieson's Pocket Book of Electrical Rules and Tables.

TORPEDOES.

4. Text-book: The Torpedo Manual. Practice will be had in making all the adjustments and tests required in planting and operating torpedoes, the operations on the water being simulated as far as practicable by special indoor appliances. Book of reference: Bucknill's Submarine Mines and Torpedoes as applied to harbor defense; Scheidnagel's Treatise upon Defensive Submarine Mining.

5. Attendance at the electrical laboratory will be regulated by the instructor. Theoretical study will be done as far as practical in quarters. All laboratory work will be done without the use of text-books, or text-book diagrams. Officers may, however, use manuscript notes or diagrams prepared before going to the laboratory. Laboratory practice will be had from 8 a. m., to 12 m., and from 1 to 5 p. m. During the last two weeks of the course each officer will prepare a plan (map and memoir) for the defense of such harbor as may be designated by the instructor, special attention being given to the torpedo defense and the batteries protecting the torpedo lines.

SURVEYING.

6. (Last two weeks of course, and preparatory to actual field work.) Subjects: (1) Adjustment, use and care of instruments; (2) Topographical surveying with transit and stadia; (3) Hydrographic surveying and gauging of rivers; (4) Geodetic surveying. Text-book: Such parts as may be designated by the academic staff, of Johnson's Theory and Practice of Surveying.

SECOND WINTER'S COURSE.

7. Civil engineering, 5 weeks; military engineering, 7 weeks; photography, 5 weeks; torpedoes, 4 weeks.

CIVIL ENGINEERING.

8. (Five weeks.) Subjects: (1) Improvement of non-tidal rivers; (2) improvement of tidal rivers; (3) canals.

9. Text-books: Vernon Harcourt's Rivers and Canals; Schlichting's Improvement of Non-Tidal Rivers. Books of reference: (see third winter's course.)

MILITARY ENGINEERING.

10. (Seven weeks.) Subjects: (1) Modern guns, carriages, and projectiles; (2) steel, compound, wrought and cast-iron armor; (3) modern ships of war and seacoast defenses; (4) modern fortifications, and their attack and defense.

11. Text-books: Such parts of the following books as may be designated by the academic staff: Woolwich Text Book of Fortifications; Maguire's Attack and Defense of Coast Fortifications; Fortifications of To-day; Inglis' paper in Professional

Papers Royal Engineers, 1884, and a lecture on armored defense in Ordnance Notes No. 151; Very's Development of Armor; Naval Intelligence Papers, June, 1886; Adams's Spezia Experiments, 1886; Baylay's Types of Modern Guns; The Protection of Heavy Guns for Coast Defense, Sir A. Clark; Abbot's Lectures on Seacoast Defense

12. Books of reference: Articles on Fortification and Gunnery, Encyclopædia Britannica; Ordnance Notes, No. 135, and Appendix; Volume 9, Professional Papers Royal Engineers; Report Board on Fortifications; Text Books on Gunnery, McKinlay; Naval Annual, 1887, Brassy.

MILITARY PHOTOGRAPHY.

13. (Five weeks.) Practice will be had in the following methods: Negatives by wet and dry processes; developers and intensifiers; silver printing, and finishing and mounting of prints; map printing; photolithography, including the negative and transfer to stone and printing. Each officer to submit 12 printed copies of his map. Text-books: Griffin's Notes on Photography; von Sothen's The Development of the Latent Image on Gelatino-Bromide of Silver.

TORPEDOES.

14. (Four weeks.) One or more officers of the second and third winter's course will be detailed weekly to report to the instructor in torpedoes, as assistant for testing core joints and instructing enlisted men on the torpedo detail.

THIRD WINTER'S COURSE.

15. Civil engineering, 10 weeks; military engineering, 6 weeks; torpedoes, 5 weeks.

CIVIL ENGINEERING.

16. (Ten weeks.) Subjects: (1) Wave and current action, and improvement of harbors; (2) steam engines and pumps; (3) building superintendence; (4) preparation of project for, or the history of, the improvement of some designated river or harbor.

17. Text-books: Such parts of the following books as may be designated by the academic staff: Vernon Harcourt's Harbors and Docks; Edward's Steam Engineers' Guide; Clark's Building Superintendence.

18. Books of reference: Rankine's Civil Engineering and Steam-Engine, Bixby's Point de Grave; articles on hydromechanics and steam-engine, in Encyclopædia Britannica; Cotterill's Applied Mechanics; Jameison on Steam-Engine; Steam Boilers, Wilson; Modern Steam-Engine, Rose; Canal and River Engineering, D. Stevenson; Construction of Harbors, T. Stevenson; Hydraulics of Great Rivers, Revy; Trautwine's Engineers' Pocket Book; Berg's Safe Building; Bullock's Architecture and Building; Billing's Ventilation and Heating.

MILITARY ENGINEERING.

19. (Six weeks.) Hanley's Operations of War, and preparation of project for the defense of such place as may be designated by the instructor.

TORPEDOES.

20. (Five weeks.) See paragraph on torpedoes in second winter's course.

COURSE FOR ENLISTED MEN.

INSTRUCTION OF ENLISTED MEN IN TORPEDOES.

21. Instruction will comprise telegraphing with the dial instrument, including the code for action and practice in the Morse system of telegraphy; the duties of the loading room, and, so far as practicable, of the boat service as prescribed in the Torpedo Manual, comprising preparing the plugs of the buoyant and ground torpedoes; charging the mines; charging the cut-off boxes, three methods; jointing the cores; making turk's heads in the electrical cable; using the junction boxes; attaching a cable stop; splicing and knotting hemp rope; inserting thimble in wire mooring

rope. They will also receive from the instructor in torpedoes or his assistant, lectures respecting the fuses, explosives, torpedo material (except that of the operating room), voltaic batteries, simple electrical testing, and the use of the portable apparatus for the electrical ignition of mines.

The "unit" detail for this instruction will consist of 1 noncommissioned officer and 4 privates. Six such details will report for duty Monday morning and will continue their instruction during fatigue hours until their work has been inspected and accepted by the officer in immediate charge. One or two of the unit details will probably finish their tasks by Tuesday evening, when other details may be made to commence work Wednesday morning. As soon as a man has had his work accepted, *i. e.*, has received a rating of "2.5," he will be excused from further attendance, and in case he has shown a commendable amount of skill and intelligence in his duties, will be a candidate for such special privileges as it may be deemed expedient to give him. A soldier qualifying twice as "2.5" will be excused from further detail during the winter season.

Recruits on their first detail will be kept under instruction indefinitely until they have done each task at least twice, and have received a rating of at least "2.0." They will then be placed on the same footing as old soldiers for further details.

The officer in immediate charge will be present in the loading rooms a large portion of each day, frequently inspecting the work of the several details. He will make it a special object to note the character of the instruction given by the noncommissioned officers, who should know their duties well, and who should be held to a strict account for any defective work that their details may do. He will rate the men as they complete their tasks by a detailed examination of their finished work and a more or less detailed course of questioning. In determining a man's "mark" regard will be had to the degree of intelligence displayed, as well as to the mechanical skill with which the work has been done. At the close of each week he will submit a "proficiency" report of the detail and state what verbal or other instruction was given during the week.

INSTRUCTION OF ENLISTED MEN IN PHOTOGRAPHY.

22. Two noncommissioned officers will be detailed each week for instruction in photography. Practice will be had in the following methods: Negatives by wet and dry processes; developers and intensifiers; silver printing, and finishing and mounting of prints; map printing.

II. The following assignment of instructors is made:

Torpedoes: Capt. C. B. Sears, Corps of Engineers.

Military engineering: Capt. R. L. Hoxie, Corps of Engineers.

Civil engineering: Capt. E. Bergland, Corps of Engineers.

Military photography: First Lieut. G. A. Zinn, Corps of Engineers, battalion quartermaster.

By order of Lieutenant-Colonel King:

J. G. WARREN,
First Lieut. of Engineers, Post Adjutant.

APPENDIX C.—PROGRAMME OF STUDY AND INSTRUCTION FOR SUMMER SEASON.

[Printed Orders No. 76.]

UNITED STATES ENGINEER SCHOOL,
POST OF WILLETS POINT, NEW YORK HARBOR,
May 2, 1891.

The following programme of study and instruction for the ensuing summer season, to commence May 4 and end November 14, 1891 (28 weeks), having been recommended by the academic staff and approved by the Chief of Engineers, will be carried into effect.

MILITARY ENGINEERING.

1. Instruction by the company officers in the nomenclature, dimensions, and construction of modern siege batteries and saps.
2. A full course of trestle and pontoon drill.
3. Instruction in building spar bridges.
4. Instruction in military mining.
5. Military map making. Each lieutenant of Engineers, who has not already

done so, and such noncommissioned officers and privates as may be selected from each company, will make satisfactory foot reconnoissances about 4 miles long in the vicinity of the post, the maps thereof to be submitted by company commanders to post headquarters on or before November 14, 1891.

TORPEDO DRILLS.

6. After receiving such preliminary practice as may be necessary to acquaint them with the practical details of preparing and planting a torpedo, the officers of the torpedo class will be divided into details of at least two officers each, for the purpose of taking charge of the preparation and planting of a grand group of torpedoes under the direction of the instructor in torpedoes, assisted by one Engineer officer of the second winter's class.

7. The senior officer will be in general charge and will keep a daily journal of operations, noting particularly any difficulties encountered and any suggestions that may occur to him, looking to the avoidance of similar difficulties in the future.

8. The officers will frequently interchange duties, so that each one shall have some experience in each part of the drill.

9. The electric light will be set up and operated.

10. The grand group being completed and the search-light in position, the post commander will order an exhibition drill illustrating the operations of the torpedo defense against an attempted passage of the mine field by an enemy's vessel under cover of night.

11. The group will then be taken up by the same detail and the parts dismantled, cleaned, and conveniently grouped for the inspection of the instructor.

12. The detail will be instructed and exercised in automatic and judgment firing drills at such times as may be most convenient before the final exhibition drill.

13. The detail of enlisted men for each grand group drill will consist of 3 noncommissioned officers and about 12 privates.

14. The hours of work will be from 7 to 11:30 a. m., and from 1 to 4:30 p. m. In bad weather, when no work is done and the men are in barracks, the latter will attend the same company duties and roll-calls as daily duty-men.

15. Weekly reports of progress will be rendered by the senior officer of the detail, and at the conclusion of the work, each officer will submit a report of the work done by him, mentioning difficulties encountered and any suggestions he may desire to make.

16. A detailed record will be kept of what each man does, with the view of tracing out the author of the defective work and determining the degree of proficiency developed by individual members of the detail. An account of the character of work done by each man will be submitted by the senior officer with his final report.

17. Occasionally, if practicable, loaded mines will be planted and fired as in actual service, height of jet, effect on neighboring mines, and other phenomena being carefully observed and recorded.

18. At such times as will not interfere with the drills above mentioned, the officers of the class will make practical experiments in calibrating commercial ammeters and voltmeters, testing efficiency of dynamos and motors.

CIVIL ENGINEERING.

19. The following instrumental surveys will begin as soon as practicable, and officers when detailed for this purpose will be excused from all other duty when actually engaged in the field work.

20. Each lieutenant of engineers, who has not already done so, will make and plot a careful instrumental survey of about 1 square mile of ground. He will be assisted in the field work by details of noncommissioned officers and privates of his company. The work will include contours 10 feet apart, determined with a surveyor's level, and will be plotted to a scale of 12 inches to the mile. Several good level bench-marks should be established and located on the map, their reference being given in a column of notes. The names of the residents should be recorded on the map. A field azimuth of one of the lines will be determined astronomically. The finished maps will be submitted on or before November 14, 1891.

21. A careful hydrographic survey of about one quarter of a square mile, including current measurements with electric current metre and double floats, will be made, if practicable, by the lieutenants of engineers who have not already done so.

FIELD ASTRONOMY.

22. All the lieutenants of engineers who have not already completed the course, and been excused from further observations, will constitute the observers, being called upon by the officer in charge as wanted, in addition, when officer of the day

(except on Sundays), the weather permitting, they will determine the error of chronometer by single altitude of sun or by east or west star, submitting computations to the instructor on day of marching off.

23. The following system will govern the observations at the observatory. The course covers two seasons—the first including theory and use of astronomical instruments, and sextant, transit, and telescope work with the instruments in the east wing and on the outer pier; and the second including sextant work, and transit and zenith telescope work, and with chronograph, with the new combined instruments in the west wing.

24. Officers wishing to use the instruments for special observations or practice, must apply for authority to do so and are not permitted to handle any instruments unless specifically assigned to them by the instructor.

25. In case of damage to instruments or apparatus, it will be promptly reported to the instructor for the action of a board of survey.

26. The following will be the ordinary routine of observations with the several instruments, after reasonable proficiency has been attained by preliminary practice.

Sextant.—After becoming skillful in the use of this instrument upon the sun, observers will deduce at least one satisfactory latitude by observing a north and a south star, using the time deduced from an east and a west star—each based on ten altitudes taken on the same night. These observations for latitude and time must be made at the observatory. The observer may get "time" from an assistant, using a portable chronometer, and will determine, by comparison, the error of standard chronometer at observatory.

Chronograph.—Daily determination, by time signal from Washington, D. C., of error and rate of astronomical clock, by roster of senior class.

Transit.—A satisfactory set of time observations will be taken by each officer on 2 nights, successive if possible, determining satisfactorily the error of sidereal clock. The junior class will employ the eye and ear method; the senior class will use the chronograph. The observer will not receive any assistance.

Zenith telescope.—Observers will first determine the level correction by daylight, using a distant terrestrial object, or at night using a slow circumpolar star. They will then find the value of a turn of the micrometer by observing Polaris at elongation. Lastly, they will observe for latitude, until they have obtained a satisfactory determination based on 3 nights' work upon not less than twenty pairs.

Astronomical azimuth.—Each officer serving his second year will determine an astronomical azimuth—using a large theodolite for the purpose.

27. Each officer shall receive instructions in the use of the personal equation machine and chronograph, and in comparison of chronometers.

28. Suitable blank forms will be provided, both for observations and computations; and all problems must be submitted, complete in every detail, upon these forms. The original records after inspection by the commanding officer will be returned to the officers as their personal property.

29. Hours of attendance at the observatory will be for both classes daily, except Saturday and Sunday, from 8 to 10 a. m., from 2 to 4 p. m., and from 8 to 10 p. m. Evening hours will be extended when it is necessary to secure complete sets of observations.

MILITARY PHOTOGRAPHY.

30. The officers' laboratory will be open daily from 1:30 p. m. to 4 p. m.

31. The building, apparatus, chemicals, etc., will be under the charge of the battalion quartermaster, whose duty it is to furnish any desired assistance, and who will be held responsible for the judicious use of the property.

32. Officers are invited to avail themselves of the advantages of the laboratory, making such arrangements with the officer in charge as shall insure no confusion in his official duties, or in those of the men under his instruction.

33. The instruction of enlisted men will be restricted to a weekly detail of one noncommissioned officer from each company.

34. The battalion quartermaster will submit to this office weekly reports showing the *nature of the instruction given*, the results attained, and the progress made.

By order of Lieutenant-Colonel King:

J. G. WARREN,
First Lieutenant of Engineers, Post Adjutant.

APPENDIX D.—TESTS OF EXPLOSIVES.

1.

REPORT OF LIEUTENANT HENRY JERVEY, CORPS OF ENGINEERS.

WILLETS POINT, NEW YORK HARBOR,
September 3, 1890.

SIR: I have the honor to submit herewith records and diagrams* of certain tests with service rifle powder ignited by a service fuse, made by me during August and September, 1890.

The diagrams explain themselves. By "work due to explosion" is meant the work indicated by the height to which the projectile was thrown. Upon the completion of line B the projectile was found to be slightly upset; it was therefore returned, and probably too much taken off, causing slight leakage of gas at the explosion. Curves α and β were made after line A.

Very respectfully, your obedient servant,

HENRY JERVEY,
Second Lieutenant of Engineers.

The POST ADJUTANT.

Tests of energy of explosives—1890.

[Weight of hammer is 36½ pounds; friction, one-half pound; if not noted, insertion is 1 inch].

Service rifle powder and service fuse, 10 grains.

Date.	No.	Feet.
Aug. 21	1	1.38
	2	1,89
	3	1.48
	4	1.28
	5	1.35
	6	1.38
	7	1.28
	8	1.11
Mean		1.39

Service fuse, i. e., 24 grs., Mrc. ful.

Aug. 21	9	0.38
	10	0.58
	11	0.56
	12	0.63
	13	0.65
Mean		0.56

Service rifle powder and service fuse, 20 grains.

Aug. 21	14	1.73
	15	1.75
	16	1.62
	17	1.58
	18	1.76
	19	1.76
	20	1.96
	21	1.80
	22	1.76
	23	1.71
Mean		1.74

Service rifle powder and service fuse, 40 grains.

Date.	No.	Feet.
Aug. 21	24	2.62
	25	2.56
	26	2.82
	27	2.38
	28	2.59
	29	2.69
	30	2.63
	31	2.68
	32	2.55
	33	2.55
Mean		2.61

Service rifle powder and service fuse, 80 grains.

Aug. 21	34	4.95
	35	4.67
	36	5.23
	37	4.98
	38	4.88
	39	5.28
	40	4.63
	41	4.13
	42	4.43
	43	4.33
Mean		4.75

Service rifle powder and service fuse, 120 grains.

Aug. 21	44	6.74
	45	6.95
	46	6.76
	47	7.38
	48	7.43
	49	7.18
	50	7.03
	51	7.73

Service rifle powder and service fuse, 120 grains.—Continued.

Date.	No.	Feet.
Aug. 23	52	6.13
	53	6.23
Mean		6.96

Service rifle powder and service fuse, 140 grains.

Aug. 23	54	7.60
	55	7.78
	56	7.34
	57	8.60
	58	8.30
	59	8.08
	60	7.98
	61	7.78
	62	7.46
	63	7.78
Mean		7.87

Service rifle powder and service fuse, 160 grains.

Aug. 23	64	7.88

Projectile refitted and retempered.

Aug. 25	65	7.88
	66	8.05
	67	8.56
	68	7.73
	69	8.65
	70	7.90
	71	8.38
	72	8.03
	73	7.81
	74	7.83
	75	8.72
	76	8.24
Mean		8.12

* Omitted.

Tests of energy of explosives, 1890.—Continued.

Service rifle powder and service fuse, 180 grains.

Date.	No.	Feet.
Aug. 25	77	9.32
	78	8.92
	79	9.69
	80	10.42
	81	10.18
	82	9.56
	83	9.38
	84	9.03
	85	10.65
	86	9.28
Mean	.....	9.64

Service rifle powder and service fuse, 200 grains.

Aug. 25	87	11.20
	88	11.13
	89	10.13
	90	10.55
	91	11.65
	92	10.32
	93	11.52
	94	10.65
	95	10.52
	96	10.50
Mean	.....	10.82

Service rifle powder and service fuse, 100 grains.

Aug. 25	97	5.40
	98	5.08
	99	5.03
	100	5.09

Service rifle powder and service fuse, 100 grains—Continued.

Date.	No.	Feet.
Aug. 25	101	4.98
	102	5.08
	103	5.04
	104	4.54
	105	5.08
Mean	.....	5.04

Service rifle powder and service fuse, 60 grains.

Aug. 25	106	3.35
	107	2.72
	108	3.18
	109	3.59
	110	3.38
	111	3.36
	112	3.03
	113	3.25
	114	3.00
	115	3.10
Mean	.....	3.20

Service rifle powder and service fuse, 30 grains.

Aug. 25	116	1.34
	117	1.74
	118	1.35
	119	1.58
	120	1.90
Mean	.....	1.58

Service fuse.

Date.	No.	Feet.
Aug. 25	121	0.33
Sept. 1	122	0.31
	123	0.35
	124	0.30
	125	0.21
	126	0.26
	127	0.23
Mean	.....	0.28

Service rifle powder and service fuse, 20 grains.

Sept. 1	128	1.15
	129	1.24
	130	1.04
	131	1.13
	132	1.18
Mean	.....	1.15

Service rifle powder and service fuse, 30 grains.

Sept. 1	133	1.80
	134	1.75
	135	1.54
	136	1.55
	137	1.67
Mean	.....	1.66

In the following experiments the tamping is assumed to be constant, being gauged by the weight of the projectile.

Service fuse.

[Insertion ½ inch.]

Date.	No.	Feet.
Aug. 26	138	0.18
	139	0.23
	140	0.24
	141	0.28
	142	0.30
Mean	.....	0.25

[Insertion 1 inch.]

Aug. 26	143	0.31
	144	0.38
	145	0.39
	146	0.37
	147	0.37
	148	0.35
Mean	.....	0.36

[Insertion 1½ inches.]

Date.	No.	Feet.
Aug. 26	149	0.33
	150	0.43
	151	0.49
	152	0.43
	153	0.38
Mean	.....	0.41

[Insertion zero.]

Aug. 26	I	0.08
	II	0.07
	III	0.07
	IV	0.07
	V	0.07
	VI	0.07
	VII	0.08
	VIII	0.08
	IX	0.09
	X	0.07
Mean	.....	0.076

[Insertion 1½ inches.]

Date.	No.	Feet.
Aug. 26	154	0.44
	155	0.53
	156	0.53
	157	0.54
	158	0.53
Mean	.....	0.51

[Insertion 1¾ inches.]

Aug. 26	159	0.60
	160	0.57
	161	0.60
	162	0.62
	163	0.60
	164	0.41
	165	0.42
	166	0.35
Mean	.....	0.52

Tests of energy of explosives, 1890—Continued.

Service fuse—Continued.

[Insertion 2 inches.]

Date.	No.	Feet.
Aug. 26	167	0.32
	168	0.36
	169	0.41
	170	0.39
	171	0.35
	172	0.41
	173	0.40
	174	0.47
	175	0.37
	176	0.36
Mean		0.38

[Insertion 2½ inches.]

Aug. 26	177	0.44
	178	0.45
	179	0.50
	180	0.45
	181	0.41
	182	0.46
	183	0.47
Mean		0.45

[Insertion 2¾ inches.]

Aug. 26	184	0.64
	185	0.47
	186	0.39
	187	0.46
	188	0.76
	189	0.56
Mean		0.55

Service-rifle powder, and 20 grains.

[Insertion ½ inch.]

Aug. 26	190	0.71
	191	0.65
	192	0.79
	193	0.63
	194	0.60
Mean		0.68

Service-rifle powder, and 20 grains—Continued.

[Insertion 1 inch].

Date.	No.	Feet.
Aug. 26	195	1.40
	196	1.09
	197	1.00
	198	1.04
	199	0.84
Mean		1.07

[Inerstion 1¼ inches.

Aug. 26	200	1.49
	201	1.18
	202	1.33
	203	1.42
	204	1.26
Mean		1.34

[Insertion 1½ inches.]

Aug. 26	205	1.81
	206	1.69
	207	1.65
	208	1.51
	209	1.53
Mean		1.64

[Insertion 1¾ inches.]

Aug. 28	210	0.92
	211	1.10
	212	1.15
	213	1.17
	214	1.28
	215	1.45
	216	1.61
Mean		1.24

[Insertion 2 inches.]

Aug. 28	217	1.45
	218	1.44
	219	1.59
	220	1.44
	221	1.69
Mean		1.52

Service-rifle powder, and 20 grains—Continued.

[Insertion 2½ inches.]

Date.	No.	Feet.
Sept. 1	222	2.28
	223	2.67
	224	2.57
	225	2.68
	226	2.68
Mean		2.58

[Insertion 2¾ inches.]

Sept. 1	227	2.76
	228	2.65
	229	2.96
	230	3.06
	231	2.89
Mean		2.86

Service-rifle powder 100 grains with service fuse and gas check. Mortar filled with cement.

[Insertion 1 inch.]

Sept. 1	232	4.39
	233	4.84
	234	4.79
	235	5.39
	236	5.27
	237	4.84
	238	5.04
	239	5.19
	240	5.44
Mean		5.02

Service-rifle powder 20 grains and service flue.

[Insertion zero.]

Aug. 26	I	0.10
	II	0.10
	III	0.12
	IV	0.10
	V	0.12
	VI	0.12
	VII	0.12
	VIII	0.11
	IX	0.12
	X	0.10
Mean		0.11

Loaded last evening, but some liquid seems to have exuded and soaked into paper. Same paper fired with the explosive. This may account for irregularities to some extent.

Rack-a-rock and safety fuse 10 grains. [Insertion, 1 inch.]

Date.	No.	Feet.
Sept. 24	241	0.51
	242	0.52
	243	0.60
	244	0.56
	245	0.72
	246	0.71
	247	0.56
	248	0.46
	249	0.48
	250	0.60
Mean		0.57

Rack-a-rock and safety fuse, 20 grains. [Insertion, 1 inch.]

Date.	No.	Feet.
Sept. 24	251	0.64
	252	0.75
	253	0.63
	254	0.76
	255	0.53
	256	0.65
	257	0.98
	258	0.84
	259	0.89
	260	0.96
Mean		0.76

Rack-a-rock and safety fuse, 40 grains. [Insertion, 1 inch.]

Date.	No.	Feet.
Sept. 24	261	1.12
	262	1.40
	263	1.30
	264	1.51
	265	1.21
	266	1.50
	267	1.50
	268	1.73
	269	1.46
	270	1.37
Mean		1.41

Tests of energy of explosives, 1890—Continued.

Rack-a-rock and safety fuse, 60 grains. [Insertion, 1 inch.]

Date.	No.	Feet.
Sept. 24	271	2.07
	272	2.53
	273*	2.04
	274	2.71
	275	2.18
	276	2.64
	277	2.47
	278	Lost
	279	2.07
	280	2.19
Mean		2.32

Dynamite No. 1, and safety fuse, 20 grains. [Insertion, 1 inch.]

Date.	No.	Feet.
Sept. 24	311	1.61
	312	1.45
	313	1.53
	314	1.54
	315	1.41
	316	1.30
	317	1.54
	318	1.55
	319	1.41
	320	1.55
Mean		1.49

Dynamite No. 1 and safety fuse, 100 grains. [Insertion 1 inch.]

Date.	No.	Feet.
Sept. 24	351	11.76
	352	12.54
	353	12.84
	354	12.44
	355	13.04
	356	11.71
	357	11.87
	358	12.29
	359	12.14
	360	11.25
Mean		12.19

Rack-a-rock and safety fuse, 80 grains. [Insertion, 1 inch.]

Sept. 24	281	3.93
	282	3.71
	283	2.74
	284	3.56
	285	3.59
	286	4.13
	287	2.86
	288	4.03
	289	3.43
	290	3.67
Mean		3.57

Dynamite No. 1, and safety fuse, 40 grains. [Insertion, 1 inch.]

Sept. 24	321	3.12
	322	2.67
	323	2.99
	324	2.96
	325	3.31
	326	3.27
	327	3.30
	328	3.36
	329	3.07
	330	3.37
Mean		3.14

Gun cotton uncompressed wet, 100 grains and safety fuse.

Oct. 2	1	12.26
	2	11.72
	3	11.01
	4	12.07
	5	11.59
	6	12.13
	7	11.22
	8	11.32
	9	12.06
	10	10.82
Mean		11.62

Rack-a-rock and safety fuse, 100 grains. [Insertion, 1 inch.]

Sept. 24	291	3.76
	292	3.74
	293	4.41
	294	3.12
	295	5.34
	296	5.19
	297	4.07
	298	5.56
	299	5.47
	300	5.34
Mean		4.60

Dynamite No. 1 and safety fuse, 60 grains. [Insertion 1 inch.]

Sept. 24	331	5.50
	332	5.62
	333	4.97
	334	5.91
	335	6.46
	336	5.44
	337	6.44
	338	6.56
	339	5.77
	340	6.37
Mean		5.90

Gun cotton uncompressed wet, 80 grains and safety fuse.

Oct. 2	11	7.54
	12	7.87
	13	8.44
	14	9.26
	15	8.01
	16	8.57
	17	8.56
	18	8.63
	19	8.71
	20	8.40
Mean		8.38

Dynamite No. 1, and safety fuse, 10 grains. [Insertion, 1 inch.]

Sept. 24	301	0.61
	302	0.83
	303	0.73
	304	0.73
	305	0.82
	306	0.73
	307	0.83
	308	0.80
	309	0.80
	310	0.83
Mean		0.77

Dynamite No. 1 and safety fuse, 80 grains. [Insertion 1 inch.]

Sept. 24	341	8.97
	342	9.11
	343	8.71
	344	7.95
	345	9.14
	346	9.01
	347	8.79
	348	9.02
	349	9.10
	350	10.49
Mean		9.03

Gun cotton uncompressed wet, 60 grains and safety fuse.

Oct. 2	21	5.95
	22	5.98
	23	5.47
	24	5.49
	25	6.05
	26	5.59
	27	5.84
	28	5.40
	29	6.03
Mean		5.76

Hammer struck, paper blazed.

Tests of energy of explosives, 1890—Continued.

Gun cotton uncompressed wet, 40 grains and safety fuse.

Date.	No.	Feet.
Oct. 2	30	3.47
	31	3.46
	32	3.50
	33	3.25
	34	3.25
	35	3.37
	36	3.24
	37	3.54
	38	3.56
	39	3.69
Mean		3.43

Gun cotton uncompressed wet, 20 grains and safety fuse.

Oct. 8	40	1.64
	41	1.63
	42	1.64
	43	1.76
	44	1.56
	45	1.18
	46	1.47
	47	1.75
	48	1.69
	49	1.57
Mean		1.59

Gun cotton uncompressed wet, 10 grains and safety fuse.

Oct. 8	50	0.77
	51	1.06
	52	1.04
	53	1.04
	54	1.09
	55	0.93
	56	0.99
	57	1.13
	58	1.03
	59	1.18
Mean		1.03

Tonite uncompressed, 100 grains and safety fuse.

Oct. 8	60	11.56
	61	11.91
	62	8.71
	63	7.26
	64	7.72
	65	8.63
	66	9.24
	67	7.39
	68	7.67
	69	7.86
Mean		8.79

Tonite uncompressed 80 grains and safety fuse.

Date.	No.	Feet.
Oct. 8	70	5.47
	71	4.86
	72	5.64
	73	5.80
	74	6.28
	75	5.86
	76	5.52
	77	5.94
	78	6.03
	79	5.77
Mean		5.72

Tonite uncompressed 60 grains and safety fuse.

Oct. 8	80	3.61
	81	3.37
	82	4.08
	83	3.79
	84	3.37
	85	3.81
	86	3.81
	87	3.99
	88	3.75
	89	3.99
Mean		3.76

Dynamite No. 1, 100 grains and service fuse.

Oct. 2*a*	1	8.77
	2	7.46
	3	8.88
	4	9.01
	5	9.23
	6*b*	8.32
	7*b*	12.00
Mean		9.095
Oct. 20*c*	8*d*	7.67
	9*d*	7.88
	10*d*	8.19
	11*d*	7.97
	12*d*	8.25
Mean		7.99
	13*e*	10.36
	14*e*	10.03
	15*e*	10.76
	16*e*	8.89
	17*e*	9.22
Mean		9.85
Oct. 21*f*	18*g*	12.44
	19*g*	13.04
	20*h*	11.71

Dynamite No. 1, 100 grains and service fuse—Continued.

Date.	No.	Feet.
Oct. 21*f*	21*h*	11.87
	22*h*	12.29
	23*i*	12.14
	24*i*	11.25
	25*i*	9.31
	26*i*	10.49
	27*i*	10.58
Mean		11.51

Tonite, uncompressed, 40 grains and safety fuse.

Oct. 20	90	2.26
	91	2.44
	92	2.43
	93	2.49
	94	2.24
	95	2.07
	96	1.87
	97	1.81
	98	2.04
	99	1.81
Mean		2.15

Tonite, uncompressed, 20 grains and safety fuse.

October 21	100	1.01
	101	1.19
	102	1.14
	103	Lost.
	104	1.28
	105	1.11
	106	1.29
	107	1.26
	108	1.28
	109	Lost.
Mean		1.20

Tonite, uncompressed, 10 grains and safety fuse.

October 21	110	0.74
	111	0.79
	112	0.81
	113	0.73
	114	0.71
	115	0.64
	116	0.82
	117	0.91
	118	0.85
	119	0.92
Mean		0.79

a Weather dry, charges weighed September 22. Stored in wooden casemate. Fired October 2.
b Fired after considerable use of hammer.
c Weather very damp and misty.
d Loaded October 9. In paper.
e Loaded October 3. In rubber.
f Weather clear. Cartridges dried in boiler room before firing.
g Loaded October 3. In rubber.
h Loaded October 3. In paper.
i Loaded October 9. In paper.

2.

REPORT OF LIEUTENANT CHARLES KELLER, CORPS OF ENGINEERS.

WILLETS POINT, NEW YORK, *May 11, 1891.*

COLONEL: I have the honor to submit the following report on tests of Columbia powder. All charges used weighed 100 grains. In each case the service fuze was used to detonate the charge:

No.	Name.	Height.	Mean.	No.	Name.	Height.	Mean.
		Feet.				*Feet.*	
1	Columbia 1 b	5.95		1	Emmensite No. 2, S. F	*c*5.85	
2	....do	6.27		2	Received November 14, 1889.	6.46	
3	....do	6.32	*a*6.17	3	Cartridge paper	7.01	*d*6.844
4	....do	6.09		4	Not paraffined	6.54	
5	....do	6.21		5	....do	6.57	
1	Columbia 1 d	5.88		6	....do	7.64	
2	....do	5.77	*a*5.8	1	Emmensite as above	7.44	
3	....do	5.75		2	Paper	7.44	
1	Columbia wet	6.06	*a*6.06	3	Paraffined after loading	7.63	*d*7.69
1	Columbia 1 b	5.76		4	....do	7.69	
2	....do	6.21		5	....do	7.96	
3	....do	6.51		6	....do	7.99	
4	....do	6.80		1	Columbia, 1d	8.47	
5	....do	6.44	*b*6.613	2	Received March 19, 1891	8.79	
6	....do	6.44		3	....do	7.87	*d*9.16
7	....do	7.24		4	Paper not paraffined	8.89	
8	....do	6.62		5	....do	11.57	
9	....do	6.71		6	....do	9.35	
10	....do	7.40		1	Columbia, 1d, as above	10.09	
11	Columbia 3 b	6.31		2	....do	11.20	
12	....do	6.51		3	Paper paraffined after loading.	10.34	*d*10.235
13	....do	6.66		4	....do	10.91	
14	....do	6.56		5	....do	9.45	
15	....do	6.93	*b*7.011	6	....do	9.42	
16	....do	7.76		1	Columbia b, white	8.49	
17	....do	7.54		2	Received March 9, 1891	7.50	
18	....do	7.59		3	Paper not paraffined	8.56	*d*8.93
19	....do	6.76		4	....do	9.93	
20	....do	7.49		5	....do	8.86	
1	Columbia 4b	7.01		6	....do	10.23	
2	....do	7.17		1	....do	10.10	
3	....do	7.31	*b*7.264	2	Paper paraffined after loading.	10.62	
4	....do	7.71		3	....do	10.35	*d*10.10
5	....do	7.09		4	....do	10.83	
6	Columbia 4d	5.41		5	....do	9.41	
7	....do	4.54		6	....do	9.51	
8	....do	4.90	*b*4.582				
9	....do	3.52					
10	....do	4.54					

a Experiments made March 24, 1891.
b Experiments made April 9, 1891.
c This observation rejected; guide rods were loose.
d Experiments of April 20, 1891, made for the purpose of determining the best form of cartridge paper.
Portland cement used instead of Rosendale in this and succeeding experiments.

From the above experiments it is seen that the cartridge paper paraffined gives results about one-eighth larger than the ordinary cartridge paper. All the cartridges used in the experiments of April 20, 1891, had been kept in store for about 1 month. Cartridges are now in store and will shortly be tried, which are made with ordinary-sized writing paper.

The Portland cement used in the later experiments appears to be preferable to Rosendale. The Portland cement being much finer, acts more in the manner of a gas check.

Respectfully submitted.

CHAS. KELLER,
Lieutenant of Engineers.

Lieut. Col. W. R. KING,
Corps of Engineers.

APPENDIX E.—TESTS OF BUILDING MATERIALS.

REPORTS OF LIEUTENANT A. M. D'ARMIT, CORPS OF ENGINEERS.

1.

WILLETS POINT, NEW YORK HARBOR, *July 29, 1890.*

COLONEL: I have the honor to submit herewith the results of the tests of sandstone sent from the Kanawha quarries by Colonel Craighill. In general the tests were conducted in the same manner as similar tests made last year. Experience seeming to indicate that pasteboard makes a better bearing surface than pine wood as used by General Gillmore, the former has been used exclusively, and the uniformity of the results and the nature of the fracture seem to justify the assumption that it is the best material yet tried. The specimens were all perfect 2-inch cubes from three different quarries; the specimens from McCoy's big and small bowlder quarries presenting little difference, however. Wishing to try something that has never before to my knowledge been done, I divided the specimens into two groups as nearly alike as possible. Those of Group I were tested in the usual manner and the results are given in the table. Group II was placed in water for 72 hours previous to crushing and then tested while in a saturated condition. The table shows the marked effect this has, the average loss of strength in both quarries being 16 per cent., so large a loss that it is well worth careful consideration where such sandstones are to be used in subaqueous structures. In the ninth column is given the ratio of absorption under 150 pounds pressure per square inch continued for 1 hour. Such absorption of water under pressure would no doubt still further reduce the strength of these sandstones, especially as it seems to have a deteriorating effect on the stone itself, rendering it extremely friable.

Very respectfully, your obedient servant,

A. M. D'ARMIT,
Second Lieutenant of Engineers.

Lieut. Col. W. R. KING,
Corps of Engineers.

	No.	Quarry.	Description.	Strength of specimen.	Strength per square inch.	Specific gravity.	Weight per cubic foot.	Ratio of absorption.	Absorption under 150 pounds pressure.	Temperature.	How crushed.	Remarks.
				Pounds.	*Pounds.*		*Pounds.*			°		
I	1	McCoy's small bowlder No. 4.	Even composition, coarse-grained, gray.	25,000	6,250	2.23	139.4	0.0568	0.0707	75	On bed..	One or two perfect cones in every case. Fractures all typical ones, with nothing especially noteworthy.
	2	McCoy's big bowlder No. 1.	A little finer, not so homogeneous, greenish tinge, chipped, not good specimen.	27,000	6,750	2.27	141.9	0.0510	0.0610	75	...do	
	3	Blue House Quarry A ..	Smooth texture, fine holes, decidedly greenish.	37,500	9,375	2.42	151.2	0.0379	0.0413	75	...do	
	4	Blue House Quarry C...	Very compact and fine, same texture as A, green.	43,000	10,750	2.46	153.7	0.0334	0.0370	75	...do	
	5	Blue House Quarry E...	Same as 3	40,000	10,000	2.50	156.2	0.0373	0.0402	75	...do	
	6	Blue House Quarry G ..	Coarser texture, layers distinct, but not homogeneous.	35,500	8,875	2.40	150.0	0.0405	0.0465	75	...do	
II	7	McCoy's small bowlder No. 3.	Same as No. 1	22,000	5,500	Practically the same as the corresponding specimens in Group I.				75	...do	All split from sides, leaving a perfectly typical cone in center. A great deal of powder and small friable fragments. All gave way by crushing rather than by the lateral splitting that characterizes sandstones in general.
	8	McCoy's big bowlder No. 2.	Same as No. 2	21,750	5,437					75	...do	
	9	Blue House Quarry B ..	Good specimen, same as Nos. 3 and 4.	34,000	8,500					75	...do	
	10	Blue House Quarry A ..	Same as 5 and 6	30,000	7,500					75	...do	
	11	Blue House Quarry F...	Same	33,500	8,375					75	...do	

Average strength per square inch.

	Dry.	Wet.	Ratio.
Blue-House Quarry	9,750	8,125	83.3
McCoy's big and small bowlders.	6,500	5,468	84.1

2.

WILLETS POINT, NEW YORK HARBOR, *April 22, 1891.*

COLONEL: I have the honor to submit herewith the results of tests ordered made on the Portland cement being used in the construction of the museum.

A mistake was made at first owing to the fact that two kinds of cement are being used and the workman obtained the wrong kind. This led to the decidedly unfavorable verbal report I made to you April 6, 1891, and an apology is due the company making the Portland cement for the report made to them on its condition. Incidentally, this mistake was valuable as showing that the Rosendale cement being used is destitute of hydraulic properties, although possessing considerable strength when dried and set in air. The tests of the Portland cement were made under the same conditions as the cement tests I made last year, a description of which is contained in my report of June 5, 1890.

The mean of 9 specimens made of one part cement and two parts sand gives 166.6 pounds breaking strength per square inch.*

Some briquettes of pure cement were tested and broke very uniformly at about 500 pounds, or a stress of 222.2 pounds per square inch of cross-section.

The behavior of the cement with sand is very creditable; but I am somewhat surprised to find that the pure cement does not give a higher tensile strength as compared to the sand briquettes.

Very respectfully, your obedient servant,

A. M. D'ARMIT,
Second Lieutenant of Engineers.

Lieut. Col. W. R. KING,
Corps of Engineers.

3.

WILLETS POINT, NEW YORK HARBOR, *June 22, 1891.*

COLONEL: I have the honor to report that in compliance with your verbal instructions I have made the additional tests requested by the Keystone Cement Company. The cement was taken from the box sent by them for this particular purpose. The briquettes were very carefully made and were exceptionally fine specimens. They were set 1 day in air and 7 [6?] in water. On testing, however, they failed to justify the claims of the Keystone Company, the maximum strain borne by the neat briquettes being 525 pounds, or 233⅓ pounds per square inch, the average being about the same as found at the previous trial.†

Very respectfully, your obedient servant,

A. M. D'ARMIT,
Second Lieutenant of Engineers.

Lieut. Col. W. R. KING,
Corps of Engineers.

[One day in air, 6 days in water.]

*Number.	Strength of specimen.	Strength per square inch.	Number.	Strength of specimen.	Strength per square inch.
1	360	160	6	412.5	183.3
2	315	140	7	322.5	143.3
3	375	166.6	8	480	213.3
4	405	180	9	375	166.6
5	330	146.6			

Mean of 9 specimens, 166.6 pounds per square inch.

[One day in air, 6 days in water.]

†Number.	Strength.	Cross-section.	Quality.
1	575	2.25 square inches.	Pure cement.
2	450	....do	Do.
3	550	....do	Do.
4	450	....do	Do.
5	575	....do	Do.
6	550	....do	Do.
Mean	525		

Strength per square inch, 233⅓ pounds.

4.

WILLETS POINT, NEW YORK HARBOR, *July 15, 1891.*

COLONEL: I have the honor to submit herewith the result of the tests made of the Rosendale cement now being used in making the concrete for the parapet.

The specimens were made as usual and under my personal supervision, so that there is no reason to suspect the workman of not making the briquettes properly. After 1 day in air the specimens were placed 6 days in water and then allowed 1 day to dry, so that the circumstances were most favorable. Notwithstanding this the sand briquettes (2 parts sand, 1 part cement) all broke with the slightest pull with the hands and could be crushed between the fingers. The pure cement did a little better. Four specimens gave 100, 120, 95, and 105 pounds, respectively, a mean of 105 pounds per briquette or 46⅔ pounds per square inch. I think this result very unsatisfactory. Compared with the tests reported by me June 5, 1890, it will be seen that the sand briquettes were about the same quality, while the neat cement seems poorer. On the whole I should say the Rosendale cement possesses very slight hydraulic properties.

Very respectfully, your obedient servant,

A. M. D'ARMIT,
Second Lieutenant of Engineers.

Lieut. Col. W. R. KING,
Corps of Engineers.

RIVERS AND HARBORS, ETC.

APPENDIX A.

IMPROVEMENT OF RIVERS AND HARBORS IN MAINE AND NEW HAMPSHIRE.

REPORT OF LIEUTENANT-COLONEL JARED A. SMITH, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. St. Croix River, Maine.
2. Lubec Channel, Maine.
3. Mooseabec Bar, Maine.
4. Pleasant River, Maine.
5. Narraguagus River, Maine.
6. Breakwater from Mount Desert to Porcupine Island, Maine.
7. Bagaduce River, Maine.
8. Penobscot River, Maine.
9. Belfast Harbor, Maine.
10. Camden Harbor, Maine.
11. Rockport Harbor, Maine.
12. Rockland Harbor, Maine.
13. Kennebec River, Maine.
14. Harraseeket River, Maine.
15. Portland Harbor, Maine.
16. Channel in Back Cove, Portland, Maine.
17. Breakwater at mouth of Saco River, Maine.
18. Saco River, Maine.
19. Kennebunk River, Maine.
20. York Harbor, Maine.
21. Portsmouth Harbor, New Hampshire.
22. Bellamy River, New Hampshire.
23. Cocheco River, New Hampshire.
24. Harbor of refuge at Little Harbor, New Hampshire.
25. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

26. Harbor of Blue Hill, Maine, with especial reference to the removal of the ledges known as Middle Ground, eastern and western.
27. Pepperell Cove, Maine, forming the eastern boundary of Portsmouth Lower Harbor.
28. Lubec channel, Maine.
29. Sullivan Falls, Hancock County, Maine.

HARBOR LINES.

30. Establishment of harbor lines at Lubec, Maine.
31. Establishment of harbor lines in Kennebec River at Bath, Maine.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 9, 1891.

GENERAL: I have the honor to transmit herewith annual reports for the fiscal year ending June 30, 1891, for river and harbor works in my charge.

In carrying on these works I have had the very faithful and able assistance of Mr. A. C. Both and Mr. F. S. Burrowes, assistant engineers.

* * * * * * *

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A 1.

IMPROVEMENT OF ST. CROIX RIVER, MAINE.

In compliance with requirements of the river and harbor act of August 11, 1888, an examination and survey of the St. Croix River was made in 1888 and 1889, and a report, with plan of improvement and estimate of cost, was submitted by the engineer officer in charge. (See Report Chief of Engineers, 1889, p. 463.)

By act of September 19, 1890, Congress appropriated $35,000 for the improvement, "upon the condition that the government of the Dominion of Canada shall expend a like sum in the improvement of the said river."

As it is not yet known what action the Dominion government is disposed to take in this matter, no steps have been taken towards the expenditure of the appropriation.

A regular line of steamers plies on the river and St. Andrews Bay, running in connection with the International Line of steamers which run between Boston, Mass., and St. John, New Brunswick.

The freights in sailing vessels are very large (principally of lumber), but it has not been practicable thus far to obtain exact statistics. Much the greater portion of the freights are shipped and received on the west side of the river (*i. e.*, in the State of Maine).

Money statement.

Amount appropriated by act approved September 19, 1890	$35,000.00
July 1, 1891, balance unexpended	35,000.00
Amount (estimated) required for completion of existing project	245,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

A 2.

IMPROVEMENT OF LUBEC CHANNEL, MAINE.

This channel lies between the eastern extremity of the State of Maine and Campobello Island, of the province of New Brunswick.

Previous to 1879 the mean low-water depth in the channel did not exceed 5 feet, and at low water of spring tides the depth was but 2 feet. Persons frequently waded from one side to the other at low water.

Dredging was first commenced in the channel October 8, 1879. The work has been carried on at intervals, as appropriations became available, until August 12, 1890, when the last dredging was completed.

At the date of last annual report dredging was in progress, under a contract with Augustus R. Wright, of Portland, Me., at a price of 35 cents per cubic yard, measured in scows. In July and August the amount of material dredged was 29,172 cubic yards, making a total of 49,458 cubic yards removed under the contract.

Previous to the appropriation of August 11, 1888, the estimated cost of completing the work as planned was $22,500. The amount appropriated was but $20,000. It was, however, thought that the amount would be sufficient, because prices had averaged somewhat less than were estimated.

In all works of dredging the measurements *in scows*, upon which payments are made, differ considerably from the measurements *in situ*, which form the basis of the estimated cost. Under the last contract the scow measurements exceeded the situ amount by nearly one-third. The excess is due to various causes, but is principally owing to the fact that situ measurements are above a definite plane and between equally definite bounds; practically the dredge removes much material below and beyond these limits; the material in scows is less compact than before being dredged, and the difference varies with location and material.

Had the entire amount estimated for completion been appropriated, the project would have been so nearly completed as to leave nothing of practical importance. The project contemplated a channel of 12 feet depth at mean low water, 275 feet wide in the reach, and 300 feet in the bends; as now completed, it has its full dimensions over most of the length, but near the upper bend the width is reduced to 220 feet. The entire amount expended upon the improvement is $168,929.42.

The resulting improvement to navigation is very great, and many sailing vessels, as well as steamers, now use the channel.

The level of mean high water above plane of mean low water is about 17 feet, and the resulting tidal currents are very strong; the channel has two bends and the current sweeps obliquely across most of its length; it is therefore difficult for vessels to navigate at low stages.

The river and harbor act of September 19, 1890, required an examination or survey of Lubec Channel. A report of the examination, accompanied by a map and estimate of cost of widening and straightening the channel, was submitted to the Chief of Engineers December 30, 1890. The report was printed in Ex. Doc. No. 158, H. R., Fifty-first Congress, second session. (See Appendix A 28.)

As the estimate submitted to Congress in report mentioned covers all that is now considered necessary, no estimate for completing the small balance of former project is here submitted.

It has not been found practicable to obtain exact statistics of vessels passing this thoroughfare. It is not local, and the statistics of Eastport and Lubec would afford a small portion only.

The channel adds greatly to the safety of Quoddy Roads as a harbor of refuge.

During the last year a new light-house has been completed on the west side of the channel and near the anchorage; it is known as Lubec Channel Light.

There is a light-house on Campobello Island at the narrows, opposite Lubec. Lubec is in the collection district of Passamaquoddy.

Money statement.

July 1, 1890, balance unexpended	$18,894.07
June 30, 1891, amount expended during fiscal year	18,823.49
July 1, 1891, balance unexpended	70.58

A 3.

IMPROVEMENT OF MOOSEABEC BAR, MAINE.

This bar is at the eastern extremity of Mooseabec Reach, near the town of Jonesport.

The Reach is a thoroughfare well protected from the sea by the adjacent islands, and it is traversed by thousands of vessels annually. The Reach also forms an admirable harbor of refuge, and is used as such by many vessels, especially in winter.

Before the improvement the bar at the east end of the Reach gave but about 6 feet depth at mean low water, and the thoroughfare was of little use save at high water.

The project of improvement consists in dredging a channel 300 feet wide and 14 feet deep at mean low water; to remove ledges in and near the channel to a depth of 16 feet, and to construct a breakwater and beacon to prevent cross currents and to mark the edge of dredged channel.

The total expenditures previous to June 30, 1890, were $53,417.68.

The expenditures in last fiscal year were $2,293.99.

Total expenditures to June 30, 1891, $55,711.67.

The cut through the bar was completed to full width of 300 feet in November, 1889.

Under the appropriation of September 19, 1890, specifications for beacon and breakwater were prepared, and in January, 1891, proposals were invited by public advertisement.

Bids were opened February 10, 1891, and a contract for the work was awarded to John F. Hamilton and Isaac H. Webber.

The first load of stone delivered under the contract was placed in the breakwater June 5, 1891. Amount of stone delivered to June 30, 1891, 1,652 tons.

It is expected that the breakwater and beacon will be completed before the close of the summer season.

It is proposed to spend the balance of appropriation remaining after completing the breakwater and beacon, and the amount which may be appropriated for the ensuing fiscal year, in removing the ledges according to the project adopted.

The improvement of this bar is in no way local in its benefits. Large numbers of coasting vessels constantly go through the Reach, as well

as many steamers; most of the vessels do not stop at all unless it be to use the anchorage as a refuge in storms.

Local statistics of freights are unimportant and do not bear upon the importance of the improvement; they are therefore not included in this report.

The improvement is in the collection district of Machias, Me. The nearest lighthouse is Moose Peak.

Nearest port of entry is Machias, Me.

NOTE.—It is not practicable to obtain tonnage statistics of this thoroughfare. The number of vessels passing annually has been estimated to be as great as 25,000. The average tonnage will hardly be less than 300, which would give the estimated tonnage 7,500,000.

Money statement.

July 1, 1890, balance unexpended		$1,582.32
Amount appropriated by act approved September 19,1890		15,000.00
		16,582.32
June 30, 1891, amount expended during fiscal year		470.61
July 1, 1891, balance unexpended		16,111.71
July 1, 1891, outstanding liabilities	$1,823.38	
July 1, 1891, amount covered by uncompleted contracts	3,497.56	
		5,320.94
July 1, 1891, balance available		10,790.77
Amount (estimated) required for completion of existing project		80,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for construction of breakwater and beacon at Mooseabec Bar, Maine, opened February 10, 1891.

No.	Name and address of bidder.	Price per ton of 2,000 lbs. for stone furnished and delivered in breakwater.	Price for beacon complete.
1	John F. Hamilton, Portland, Me., and Isaac H. Webber, Chebeague, Me	$0.97	$2,670.00

The contract was awarded to Hamilton & Webber.

A 4.

IMPROVEMENT OF PLEASANT RIVER, MAINE.

In compliance with requirements of the river and harbor act of August 11, 1888, an examination of this river was made by the engineer officer in charge in November, 1888, and a survey was made in August, 1889.

Owing to the small amount of funds which could be allotted for the purpose, the survey of the river from Columbia Falls to Addison Point was little more than a reconnoissance, and below that point the survey

was limited to a small area where there are obstructions known as Coffin Rocks and Channel Rocks.

The project for improvement comprises only the marking of the rocks by beacons and the removal of a few bowlders from the channel above Addison Point, at a total estimated cost of $3,500.

A project has been adopted to erect one stone beacon and one iron spindle to mark the Channel Rocks and Coffin Rocks, and to remove such bowlders as may be found.

The work is so small in amount, so varied, and so remote from any commercial or business centers that it has not been considered judicious to do the work by contract after public advertisement. A recommendation was therefore submitted and approved for constructing the beacon and spindle and removing the bowlders by hired labor and purchase of material in open market. Arrangements have been made for commencing the work, and it will be completed during the ensuing summer.

Money statement.

Amount appropriated by act approved September 19, 1890	$3,500.00
July 1, 1891, balance unexpended	3,500.00
July 1, 1891, outstanding liabilities	270.60
July 1, 1891, balance available	3,229.40

COMMERCIAL STATISTICS.

Exports:	Tons.	
Lumber	12,400	
Bricks	14,875	
Blueberries (canned)	500	
		27,775
Imports:		
Coal	2,500	
Wood	1,980	
		4,480
Total tonnage		32,255

Three vessels of 350 tons each were built during the year.

A 5.

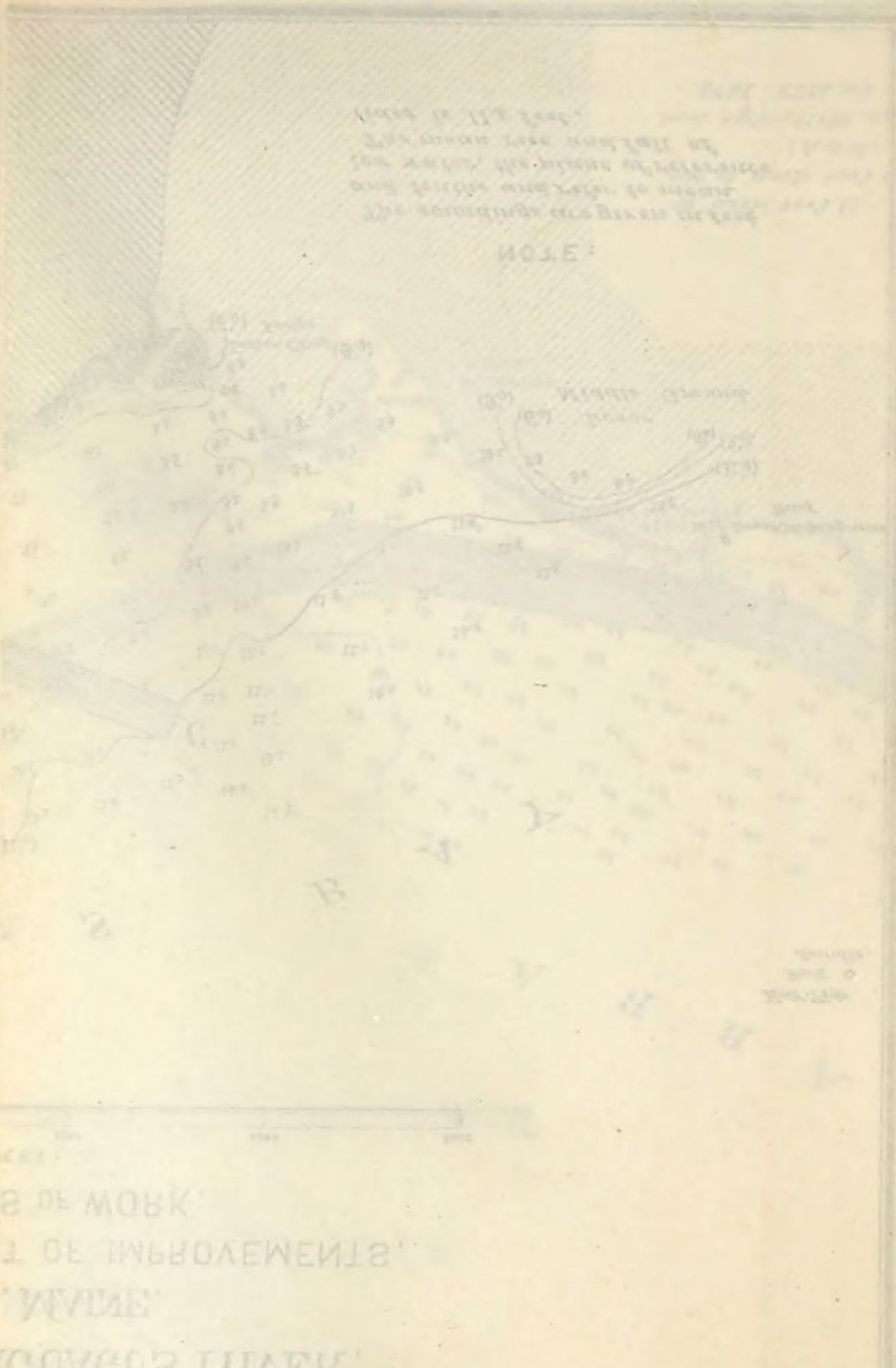
IMPROVEMENT OF NARRAGUAGUS RIVER, MAINE.

The part of the river comprised in the project for improvement is at the mouth of the river proper and at the head of Narraguagus Bay, below the village of Millbridge, which is near the head of tidewater.

The river is navigable for small vessels as far up as Cherryfield, 5 miles above Millbridge.

Before the improvement was begun the bar at the mouth of the river gave less than 6 feet depth of water at mean low tide.

The project for improvement, originally estimated to cost $50,000, consists in deepening the channel over the bar by dredging to a depth of 11 feet to the steamboat landings and then 9 feet deep to the anchorage.



NOTE:

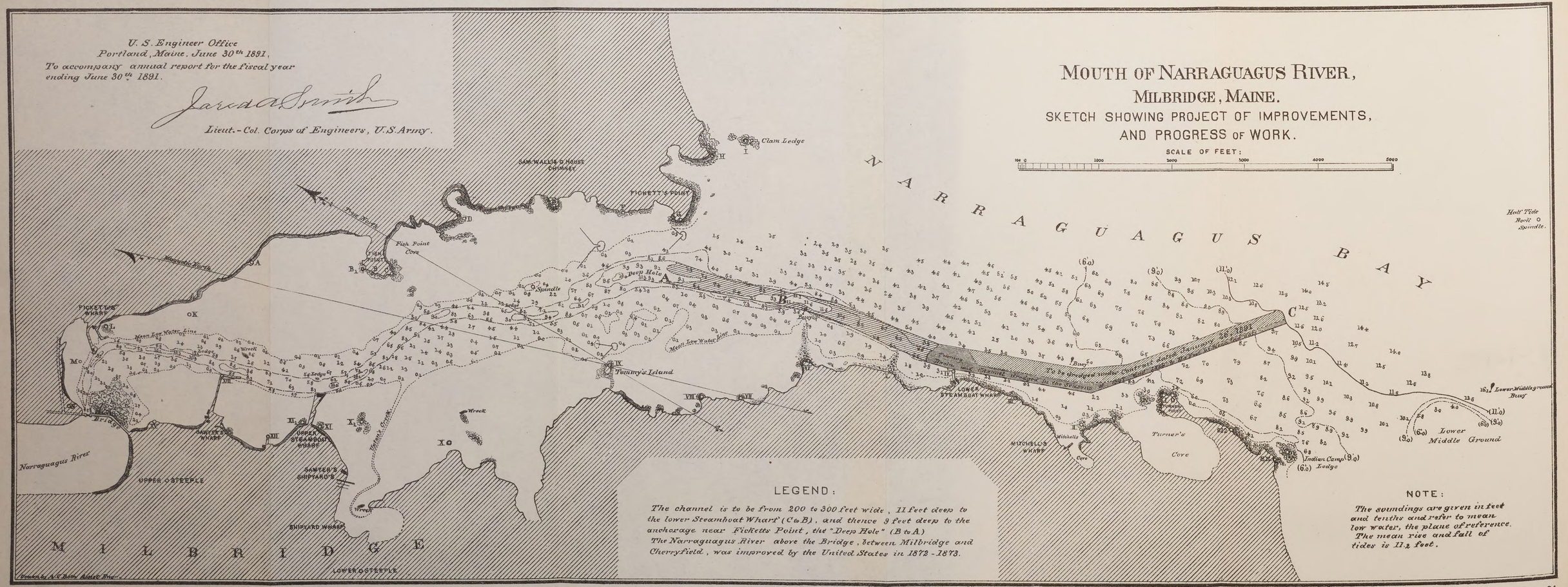
U. S. Engineer Office
Portland, Maine, June 30th 1891.
To accompany annual report for the fiscal year ending June 30th 1891.

Jared A. Smith

Lieut.-Col. Corps of Engineers, U.S. Army.

MOUTH OF NARRAGUAGUS RIVER,
MILBRIDGE, MAINE.
SKETCH SHOWING PROJECT OF IMPROVEMENTS, AND PROGRESS OF WORK.

SCALE OF FEET: 100 0 1000 2000 3000 4000 5000



LEGEND:

The channel is to be from 200 to 300 feet wide, 11 feet deep to the lower Steamboat Wharf (C to B), and thence 9 feet deep to the anchorage near Ficketts Point, the "Deep Hole" (B to A)
The Narraguagus River above the Bridge, between Milbridge and Cherryfield, was improved by the United States in 1872-1873.

NOTE:

The soundings are given in feet and tenths and refer to mean low water, the plane of reference.
The mean rise and fall of tides is 11.2 feet.

Eng 91

Previous to June 30, 1890, the expenditures had been $20,000.
In the last fiscal year the expenditures have been $5,956.20.
Under the appropriation of September 19, 1890, specifications were prepared and proposals for dredging were invited by public advertisement.

The amount of appropriations being very small, this work was combined with improvements by dredging at Belfast, Camden, and Rockport, Me., to be let in a single contract, but with a separate price for dredging each locality. The total of appropriations for four improvements thus combined is but $28,500, but the effect has been to obtain exceptionally low prices, which could not have been expected had each work been let separately.

Proposals were opened December 30, 1890, and the contract was awarded to the firm of Moore & Wright, whose aggregate bid for the four works was lowest.

Under this contract work was commenced May 16, 1891. At the end of the fiscal year the amount dredged under the contract was 61,740 cubic yards. Dredging under the contract will probably be completed about the middle of July.

Most of the material dredged is a hard bluish mud resembling clay; also some gravel, shells, and stones. Small portions of the channel previously dredged have been filled by sawdust, which apparently comes down the river from mills at or above Cherryfield.

A small map, showing the locality and extent of the improvement, is forwarded to accompany this report.

The names of parties who are violating the provisions of section 6 of river and harbor act of September 19, 1890, have been obtained for information of the Department of Justice, under provisions of section 11 of the act mentioned.

The commerce of the Narraguagus River is not extensive, but a considerable area of country is dependent upon it for shipments of lumber and for miscellaneous freights.

The improvement is in the collection district of Machias. The nearest port of entry is Machias. Nearest light-house is Narraguagus Light-house, on Pond Island. One steamer touches at Millbridge four times per week for about 9 months each year. Other steamers touch at the same point during a few of the summer months.

Money statement.

Amount appropriated by act approved September 19, 1890		$7,500.00
June 30, 1891, amount expended during fiscal year		2,341.57
July 1, 1891, balance unexpended		5,158.43
July 1, 1891, outstanding liabilities	$3,614.63	
July 1, 1891, amount covered by uncompleted contracts	1,502.17	
		5,116.80
July 1, 1891, balance available		41.63
Amount (estimated) required for completion of existing project		22,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		22,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging and removing ledge in Rockport Harbor, and dredging in Belfast Harbor, Camden Harbor, and Narraguagus River, Maine, opened December 30, 1890.

No.	Name and address of bidder.	Price per cubic yard of material, measured in scows.					
		Narraguagus River.	Belfast Harbor.	Camden Harbor.	Rockport Harbor.		
					Dredging.	Removing ledge.	
		Cents.	*Cents.*	*Cents.*	*Cents.*		
1	National Dredging Company, Wilmington, Del	15	15	15	15		$15.00
2	Andrew K. Stone, Roxbury, Mass	20	18	22	22		28.00
3	A. B. Martin, Boston, Mass	18	18	18	18		25.00
4	Hamilton & Sawyer, Chebeague, Me	17½	17½	17½	17½		25.00
5	Moore & Wright, Portland, Me	8½	15	18	22		20.00

The contract was awarded to Moore & Wright, Portland, Me., their bid being the lowest in the aggregate.

COMMERCIAL STATISTICS.

The following commercial statistics were courteously furnished by Mr. L. G. Means, of Millbridge, Me.:

Arrivals of coasting vessels (schooners)	240
Arrivals of foreign vessels (barks and brigs)	10
Departures	250
Receipts (by water) at Millbridge and Cherryfield:	Tons.
Merchandise	22,250
Hides	450
Total	22,700
Exports:	
Lumber (long)	40,000
Lumber (short)	1,500
Paving stones	2,000
Leather	300
Total	43,800
Total tonnage	66,500

A 6.

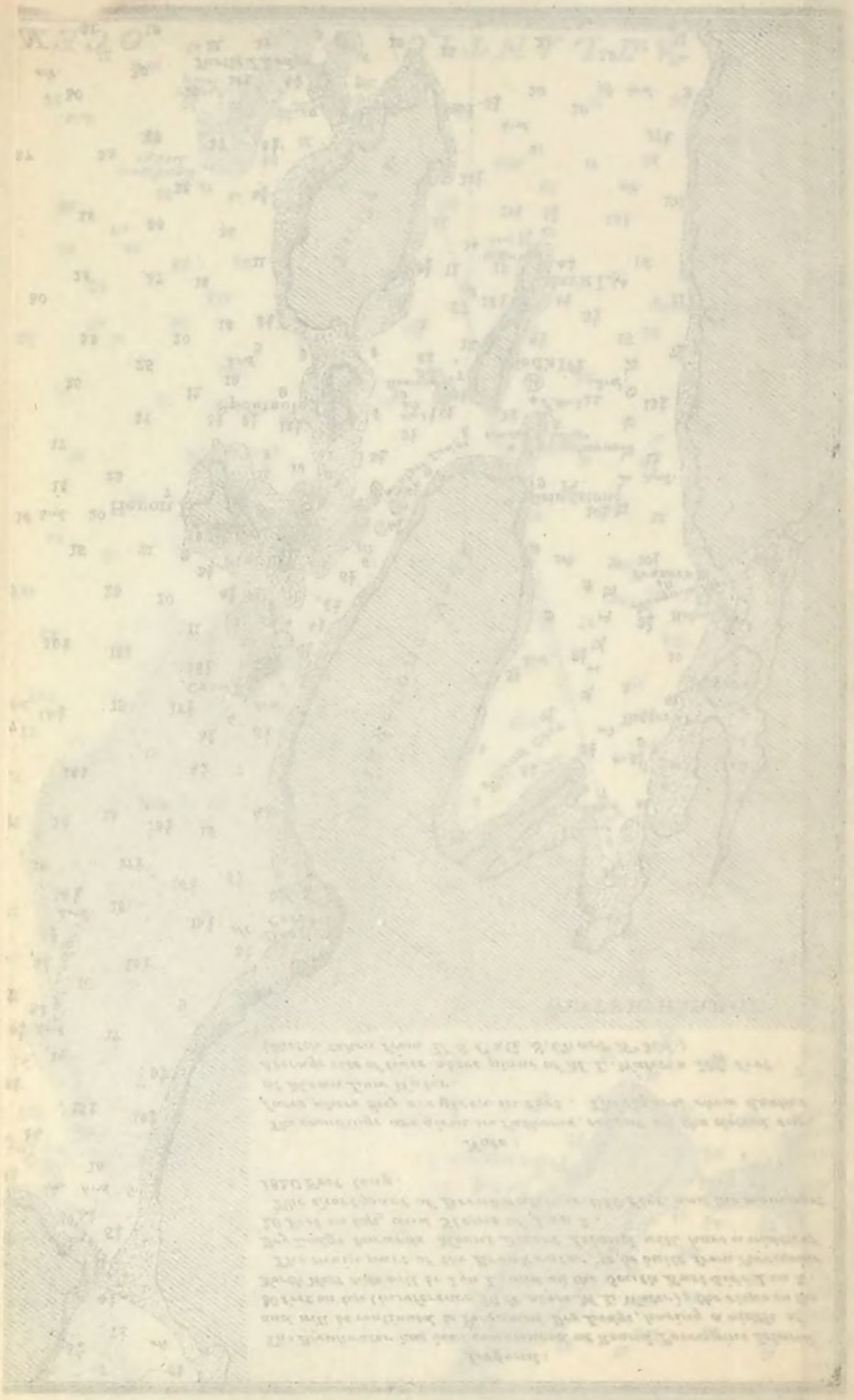
BREAKWATER FROM MOUNT DESERT TO PORCUPINE ISLAND, MAINE.

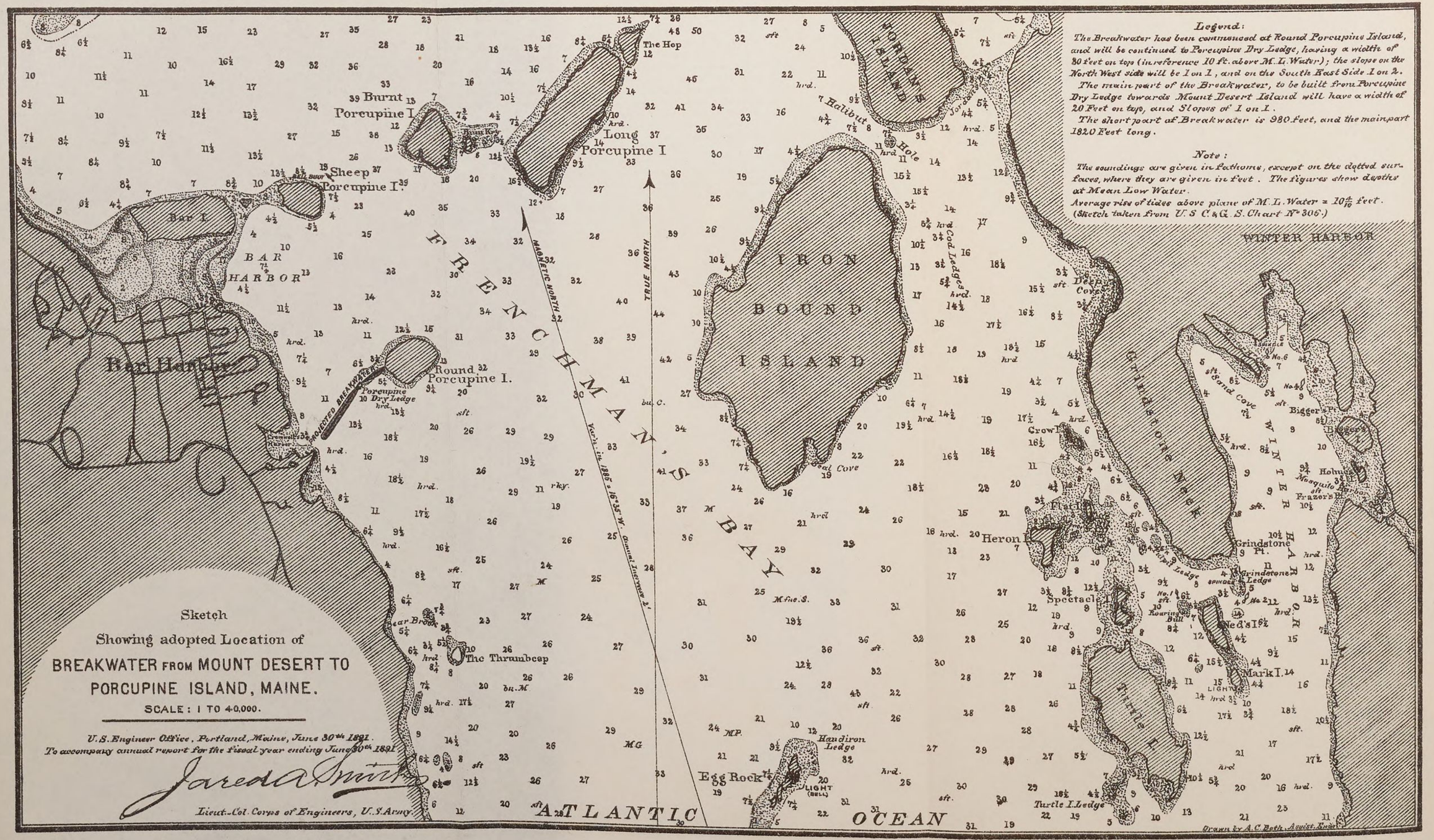
The necessity for improving this harbor arises from the fact that it is exposed to all winds and seas from the south and southeasterly directions, making the anchorage at times so insecure that vessels are unable to hold their positions.

At such times the landing of passengers and freight at wharves is not only difficult but dangerous.

The project originally adopted for the improvement was to construct a breakwater from Porcupine Island to Dry Ledge, and thence in a direct line to a point near the shore of Mount Desert Island, a total distance of 3,425 feet. The location and estimate of cost was based upon the depths of water shown upon coast chart of Bar Harbor.

Soundings taken in May, 1889, indicate that the depths of water given on coast chart at the site of breakwater are much too small, and the quantities of stone would be necessarily increased. The officer in charge of the work therefore recommended that the location of the part east of Porcupine Ledge be changed to a line from the ledge to




Legend:
The Breakwater has been commenced at Round Porcupine Island, and will be continued to Porcupine Dry Ledge, having a width of 30 feet on tops (in reference 10 ft. above M.L.Water); the slopes on the North West side will be 1 on 1, and on the South East Side 1 on 2.
The main part of the Breakwater, to be built from Porcupine Dry Ledge towards Mount Desert Island will have a width of 20 Feet on tops, and Slopes of 1 on 1.
The short part of Breakwater is 930 feet, and the main part 1820 Feet long.
Note:
The soundings are given in Fathoms, except on the dotted surfaces, where they are given in feet. The figures show depths at Mean Low Water.
Average rise of tides above plane of M.L.Water = 10 4/10 feet.
(Sketch taken From U.S.C.&G.S.Chart N° 306.)
Sketch
Showing adopted Location of
BREAKWATER FROM MOUNT DESERT TO PORCUPINE ISLAND, MAINE.
SCALE: 1 TO 40,000.
U.S.Engineer Office, Portland, Maine, June 30th 1891.
To accompany annual report for the fiscal year ending June 30th 1891
Jared A. Smith
Lieut.-Col. Corps of Engineers, U.S.Army.
Bar Harbor
BAR HARBOR
Bar I.
Burnt Porcupine I.
Sheep Porcupine I.
Long Porcupine I
The Hop
Round Porcupine I.
Porcupine Dry Ledge
PROJECTED BREAKWATER
FRENCHMAN'S BAY
MAGNETIC NORTH
TRUE NORTH
Variation 1895 = 16° 35' W. Annual Increase 2'
IRON BOUND ISLAND
HORSE I.
Halibut
Hole
Cod Ledge
Deep Cove
Sand Cove
Crowl
Heron I.
Flat I.
Spectacle I.
Ned's I.
Mark I.
Turtle I.
Grindstone Ledge
Grindstone Pt.
Bigger's Pt.
Frazer's Pt.
Mosquito
Holmes
No.6
No.4
No.1
Bell
Turtle I. Ledge
Egg Rock
LIGHT (Bell)
Hændiron Ledge
Thrumbcap
Spar Brook
Seal Cove
WINTER HARBOR
GULLIVER'S HOLE
ATLANTIC OCEAN
Drawn by A.C.Roth, Assist. Engr.

Eng 91

point south of the cove known as Cromwell Harbor. The breakwater is thus shortened to a length of about 2,800 feet.

A small map accompanies this report to show the location of the harbor and breakwater.

It was also recommended that the cross section of the breakwater be modified to give a width of but 20 feet on top instead of 30, and that the slopes be one on one.

The modification of plan and section was approved December 17, 1890.

The estimated cost of the breakwater as now modified is:

For breakwater from Round Porcupine Island to Porcupine Ledge..tons..		66,000
For extension of breakwater southwest from Porcupine Ledge.....do...		554,000
A total of 620,000 tons, at $1.30.....		$806,000

Probably no superstructure may be required, and if built at all it is to be deferred until the rough stone work is completed. The estimate for a superstructure may therefore very properly be omitted at present.

The contract with Mr. Fred. L. Andrews, who was mentioned in last report as having abandoned his contract, expired June 30, 1890, by limitation of time. As it appears that suit against bondsmen can not be brought until the United States can show actual increase of cost, it became necessary to advertise the work and make a new contract.

Proposals for completing the work on which the former contractor had failed were invited by advertisement dated August 25, 1890.

Proposals were opened September 25, 1890, and the contract was awarded to Mr. T. Rhys Smith, of New York, who was the lowest bidder.

It is not practicable to carry on work at Bar Harbor in the late autumn, winter, or early spring months. The first stone placed in the breakwater under the new contract was delivered April 25. Since that date work has been progressing fairly, though not as rapidly as could be desired.

The amount of stone delivered to June 30, 1891, has been 6,127 tons.

Expended to June 30, 1890, $13,711.78.

Expenditures in last fiscal year, $9,081.27.

Total expenditures to June 30, 1891, $22,793.05.

By act of September 19, 1890, Congress appropriated $50,000 for continuing work upon the breakwater. As the last contract is still incomplete, it has been considered advisable to defer making another contract until it could be seen whether the present contractor is to carry on the work with ability and dispatch.

Advertisements will be issued at an early day inviting proposals for continuing the construction of breakwater under the latest appropriation.

Bar Harbor is in the collection district of Frenchman Bay. The nearest port of entry is Ellsworth. The nearest light-house is on Egg Rock, 3½ miles distant.

Money statement.

July 1, 1890, balance unexpended.....		$36,288.22
Amount appropriated by act approved September 19, 1890		50,000.00
		86,288.22
June 30, 1891, amount expended during fiscal year.....		5,432.75
July 1, 1891, balance unexpended		80,855.47
July 1, 1891, outstanding liabilities.....	$3,648.52	
July 1, 1891, amount covered by uncompleted contracts.....	24,625.63	
		28,274.15
July 1, 1891, balance available		52,581.32

Amount (estimated) required for completion of existing project.....$706,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 150,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for furnishing and placing stone on breakwater at Bar Harbor, Me., opened September 25, 1890.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	
		Outer stone, top and slope.	Stone filling of the core.
1	Anson H. Bangs, Fayetteville, N. Y	$1.47	$1.47
2	John Thomas Higgins, Henry Milton Eaton, William Augustus Milliken, Bar Harbor, Me.	2.25	1.25
3	Thomas Rhys Smith, 59 Liberty street, New York	1.23½	1.23½
4	Wm. P. Hurley, Rockland, Me	1.24	1.24
5	George Willett Andrews, Biddeford, Me	1.43	1.43
6	Rufus A. Soule, Chebeague, Me	1.47	1.47

The contract was awarded to T. Rhys Smith.

COMMERCIAL STATISTICS.

Number of arrivals, departures, and aggregate tonnage of each class of vessels during the year 1890, at Bar Harbor, Me.

Class of vessels.	Number of vessels.	Aggregate tonnage.	Number of arrivals.	Number of departures.
Steam vessels	11	5,222	3,665	3,665
Sailing vessels	.....	15,000	300	300

A great number of yachts, of which no record was kept, from the largest ocean-going yacht to the smallest fair-weather craft, visited Bar Harbor during the yachting season.

In the steamers a large amount of freight is exported and imported, and a large number of passengers arrive and depart; the exact number could not be ascertained.

The receipts by sailing vessels were as follows:

	Tons.		Tons.
Coal	5,000	Gravel	1,500
Lumber	300	Hay	475
Wood	1,200	Merchandise	400
Building stone	1,200		
Bricks	200	Total	10,275

No new lines of transportation established.
Total tonnage of all arrivals and departures, 718,826 tons.

A 7.

IMPROVEMENT OF BAGADUCE RIVER, MAINE.

The channel near South Penobscot is very crooked and obstructed in one place by ledges of rock, and has a low-water depth not exceeding 2 feet in places. The channel at this place is in the southern part of

the broad place known as Northern Bay. Its situation is fully shown upon Coast Survey Chart No. 311.

The project for its improvement is to dredge the channel and remove the rock to give a width of 100 feet and a low-water depth of 6 feet from South Penobscot to Bridge Point; it also includes the removal of a small amount of rock in Johnson Narrows near Southern Bay.

By act of August 11, 1888, Congress appropriated $3,000 for the improvement. This small sum could not be judiciously expended, and it was therefore held to await further action of Congress, save the amount of $100 expended in preparing plans, etc.

By act of September 19, 1890, Congress appropriated the further sum of $4,000.

The entire improvement was estimated to cost $46,875, of which about $25,000 is for the removal of rock. To effect any permanent and valuable improvement the rock should be first removed.

The funds now available are insufficient to effect any radical improvement, as the expense of tools, etc., is considerable.

If done by contract there could be no competition for the work and prices would be high.

It has therefore been considered most expedient to do the work by hired labor and purchases in open market as far as funds will permit.

It is probable that operations can not be conveniently commenced until the summer of 1892, when any further appropriation, if made, may be added to amount now available.

No recent statistics have been obtained. At the time of the examination and survey in 1886 and 1888 the exports of bricks and wood were about 21,000 tons annually.

The improvements would reduce the cost of freight at least 25 cents per ton, by the use of larger vessels and saving of lighterage.

The improvement is in the collection district of Castine. The nearest port of entry is Castine, at the mouth of the river. The nearest light-house is at Dice Head.

Money statement.

July 1, 1890, balance unexpended	$2,900.00
Amount appropriated by act approved September 19, 1890	4,000.00
July 1, 1891, balance unexpended	6,900.00
Amount (estimated) required for completion of existing project	39,875.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	39,875.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

A 8.

IMPROVEMENT OF PENOBSCOT RIVER, MAINE.

The channel at Bangor and near Crosby Narrows was originally too narrow to accommodate the numerous vessels and rafts.

A project was adopted in 1884 to widen the channel to 300 feet, giving 11 feet depth at extreme low water at Bangor and 12 feet depth at Crosby Narrows.

In 1888 an additional project was adopted to deepen the shoals between Bucksport and Winterport to 22 feet at low water.

Estimate of cost of part above Crosby Narrows was	$75,000.00
Of the part below Winterport	365,000.00
Total	440,000.00
Appropriations and allotments for first part of improvement to June 30, 1891	55,000.00
Allotment for part below Winterport	30,000.00
The act of September 19, 1890, appropriated "for continuing the improvement and for dredging near Sterns Mill"	25,000.00
Total of appropriations	110,000.00

Expenditures to June 30, 1891:

Above Crosby Narrows	$50,240.02
Below Winterport	31,517.58
From appropriation September 19, 1890	368.50
Total	82,126.10

At the beginning of the fiscal year dredging was in progress above Crosby Narrows under a contract which had been extended to September 30, 1890.

Although a large dredge was employed, progress was very slow in removing the mass of slabs, edgings, and other mill waste which had become tangled and pressed together with a filling of sandy mud. The time for completion of work under the contract has therefore been extended several times, the latest limit being December 31, 1891.

Dredging was carried on continuously until November 22, when ice formed to such an extent as to cut mooring lines, etc., and compelled a suspension for the winter. Owing to various difficulties encountered by the contractor, dredging has not since been resumed. But a small amount, however, remains to be done under the contract, and it will doubtless be done before the close of the season.

The amount already removed, commencing July 1, 1890, is 50,430 cubic yards, and to do this has occupied a powerful dredge 4 months and 22 days.

The improvement to the channel is simply one of widening, the old channel being too narrow for convenient navigation.

A very serious difficulty in carrying on this work is the disposal of the material. It is entirely impracticable to tow the slabs and sticks some 25 miles in order to dispose of them beyond the limits of the river, and it is equally impracticable to raise them up the bank and leave them upon land belonging to private individuals. It is quite impossible to burn this water-soaked waste, and the only alternative after removing it from places in the way of navigation is to dump it in other places out of the way which seem to offer least opportunity for its again becoming an obstruction.

As far as possible care has been taken in dumping to avoid any injury to the interests of riparian owners, but where the river is used as an ice field in winter private interests become so strong that it is impossible to avoid many complaints.

The dredging of channel at Frankfort Flats between Winterport and Bucksport, which was in progress at date of last annual report, was completed July 24. The amount dredged in July was 15,033 cubic yards, making a total of 152,376 cubic yards, measured in scows, dredged under the contract. The channel dredged is shown upon map opposite page 516, Report of Chief of Engineers for 1889.

Immediately above the improvement at Crosby Narrows, on the opposite side of the river, is a large sawmill known as Sterns Mill. An

immense bar of mill waste has formed on the west side of the river above this mill and a point of the bar projects down nearly opposite the wharf.

The river and harbor act of September 19, 1890, provided for continuing improvement upon the Penobscot River and for dredging near Sterns Mill. The following correspondence and report on this subject is therefore given:

BANGOR, ME., *July 8, 1890.*

DEAR SIR: We earnestly desire a recommendation and appropriation for the removal of a shoal formed on our river (Penobscot) not included in the proposed improvement, and above where any survey has been furnished the Government. It is in the midst of the busiest portion of the river and is a serious obstruction to navigation. It is formed of the waste from sawmills, and is in what was once the deepest and widest channel of the river.

We have called the attention of Colonel Smith, engineer in charge of improvements in that vicinity, to the obstruction, and he can easily make a report if so ordered.

A great obstacle to the removal of this shoal on this part of the river is finding a place for the dumping of the deposit; but in the matter of the removing this shoal, which is called "the bar above Sterns Mill," a dumping ground near by is afforded by us. Hoping to hear through our esteemed Congressman, Boutelle, that our prayer is heard and the work will go on this season,

We are, very respectfully yours,

S. & E. L. STERNS.
HARLAN P. SARGENT.
AMERICAN ICE COMPANY,
By F. H. CLERGUE, *President.*
T. J. STEWART & CO.
HENRY LORD.

Hon. REDFIELD PROCTOR,
Secretary of War.

BANGOR, ME., *July 12, 1890.*

MY DEAR GENERAL: There is a bad shoal in the Penobscot River, in the immediate vicinity where the dredging is now going on, that is very troublesome to shipping in the lumber and ice business. Colonel Smith has been here and satisfied himself that it should be dredged, and I inclose a letter from property owners in regard to it. What is desired, if possible, is that work may be prosecuted upon the shoal this season under the existing appropriation, which is general, I think, for work on the Penobscot River near Crosby Narrows. If you can give any instructions that will facilitate this work it will be of much service on our river, where the tonnage engaged in the ice business, etc., is rapidly increasing.

Yours, very truly,

C. A. BOUTELLE, *M. C.*

Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
July 15, 1890.

Respectfully referred to Lieut. Col. Jared A. Smith, Corps of Engineers, for report.
To be returned.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 31, 1890.

Respectfully returned to the Chief of Engineers.
A report and estimate is made in a separate communication of this date.

JARED A. SMITH,
Lieut. Col., Corps of Engineers, U. S. A.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 31, 1890.

GENERAL: Refering to my indorsement of this date upon letter of Hon. C. A. Boutelle, referred for report with indorsement of Chief of Engineers, dated July 15, 1890, I have the honor to submit the following report:

The latest map of the location is from a survey made in 1872, and some slight changes in the channel have occurred since that date, but probably not enough to make a radical difference in the general features.

The matter was brought to my attention a few weeks ago, and from the statements made regarding the grounding of vessels on the shoal there seemed to be but little doubt of the necessity for its removal.

A study of the map, however, shows that the channel for purposes of general navigation is already better at that point than it is at most places above and some places below.

At the place where the shoal is said to be most of an obstruction the width of channel exceeding 12 feet deep at extreme low water (about 15 feet at mean low water) is now 350 feet in a straight reach, while in the bend above, of which no complaint has thus far reached this office, the width between same contour lines is less than 200 feet.

If the channel has filled since the survey of 18 years ago it would indicate that the width was already too great to be permanently maintained by natural conditions, and that any further increase of width would cause still further shoaling.

An examination of the map shows that the shoal projects partially over the front of Sterns Wharf, and entirely covers the front of a small additional wharf recently constructed at Sterns Mills.

There is, however, a good channel which extends behind the shoal along the entire wharf front.

Any abrupt widening of the channel so as to remove the shoal from the front of the wharves would tend to cause a shoaling in the main channel already existing, and a general widening of the channel, as indicated in red upon the map, would only partially remove the local difficulty, and would not facilitate general navigation to the extent of the expense it would entail.

It is my opinion that a buoy to mark the extremity of the shoal in front of the wharf will be sufficient to keep vessels in the channel, and that any widening is at present unadvisable.

The estimated cost of widening the channel as indicated in red upon the map is as follows, viz:

Thirty-five thousand cubic yards slabs and other mill waste measured in scows at 50 cents per cubic yard, $17,500.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

For the reasons stated in the foregoing report, no recommendation has been submitted for dredging near Sterns Mill.

The greatest present obstruction to navigation on the river is between Bucksport and Winterport, near the point known as High Head. The officer in charge of the work believed that the only certain method of producing a permanent improvement at this place is by contraction works to modify the direction and velocity of ebb and flood currents.

A project was accordingly submitted.

The project and action thereon is given as follows, omitting the map:

UNITED STATES ENGINEER OFFICE,
Portland, Me., April 25, 1891.

GENERAL: I have the honor to submit the following project for expenditure of $25,000 appropriated by the act of September 19, 1890, for improving the Penobscot River, Maine, "continuing improvement, and for dredging near Sterns Mill."

The approved projects for improving the Penobscot River consist in widening the channel at Bangor and Crosby Narrows by dredging and deepening the channel below by dredging and contraction works.

The act of August 11, 1888, divided the appropriation between two parts of the river by an allotment to each.

The "dredging near Sterns Mill" authorized in the act is not at present considered necessary. In this connection I refer to a letter of Hon. C. A. Boutelle to the

Chief of Engineers, dated July 12, 1890, * * * and to my report thereon, dated July 31, 1890.

The widening of channel at Crosby Narrows is not completed, but it is at present far less important than the deepening of the channel between Bucksport and Winterport.

To explain the reasons for the project here proposed a brief history of the work becomes necessary.

For this portion of the improvement the only method for deepening the channel which I have considered suitable for the purpose is by contraction works.

My project of December 28, 1888, for expenditure of $30,000 allotted by act of August 11, 1888, for improving the river between Bucksport and Winterport was for the construction of a jetty to contract the cross section, and change the direction of flood-tide currents.

The project was referred to the Board of Engineers, and was not approved, as the Board preferred "dredging a channel to the required depth and as wide as possible near Jetty C before dikes were built." (Report of the Chief of Engineers, 1889, pages 516 to 522.)

A careful examination of the bottom made subsequent to the Board's recommendation, above mentioned, fully satisfied me of its light and changeable character, and that such expenditure would produce no good results.

A reconsideration of the subject was therefore urged in my letter of June 27, 1889.

From the survey of 1887 the amount of material, *in situ*, necessary to be removed to give a depth of 22 feet at low water in the channel finally dredged was 134,057 cubic yards.

When the dredge arrived to commence work August 1, 1889, a considerable part of the area for which dredging had been planned was found to be scoured from a few inches to a few feet below grade, and a new survey had to be made before the work could be carried on with regularity.

From the survey made at that time the amount of material *in situ* above grade, between the same lines as before, was but 72,593 cubic yards, a little more than one-half the amount found by the first survey.

The dredge then commenced and continued until compelled to suspend for the winter; the work was resumed in the spring and completed July 24, 1890, the total amount removed, as measured in scows, being 152,376 cubic yards. The cuts were made considerable below grade in order to obtain as good a result as possible.

Probably the amount dredged *in situ* was as large as the scow measurement, for the material was in great proportion clear sawdust, which was held so nearly in suspension by the water that when disturbed it was carried long distances by the current, and from that cause became an annoyance to towboats on the river, by accumulating in pumps and boilers.

About three months after the completion of the dredging, the channel was again surveyed and the *situ* measurement above grade in the areas dredged was found to be 92,083 cubic yards, or about 19,500 yards more than when dredging was commenced. Most of the filling was in the part of channel dredged in the first season. The edge of the channel dredged a short time previous to the survey did not show much change.

From the conclusion of work until the last survey was made the river was at the ordinary summer stage, and the conditions to produce change were therefore minimum.

The results may be summed as follows:

Channel at Frankfort Flats.

	Cubic yards.
Material above grade in 1887, *situ*	134,057
Material above grade in August, 1889, *situ* (before dredging)	72,593
Amount dredged to July 24, 1890, scow measurement	152,376
Material above grade October, 1890, *situ*	92,083

In a separate package I forward a tracing to accompany this project. At Frankfort Flats the area actually dredged to a depth of nearly 24 feet is shown in red. The southwest side was dredged in the summer and fall of 1889, and the northeast side in the spring and summer of 1890.

At High Head, shown on same tracing, the soundings in red were taken in 1887. When borings were made in 1889 the depth was found to have changed so much that of nine places examined but one had the same as before; in seven places the depths were from 3 feet to 8.6 feet less than before, and in one place the depth had increased 2.7 feet.

A few soundings which are shown in black were taken in October, 1890. They are not complete, but are sufficient to indicate that the bar fluctuates greatly from year to year.

At latest reports the greatest obstruction on the river was the bar at High Head.

The shifting character of the material is sufficient to indicate that deepening by dredging would give no permanent result.

I therefore recommend that the appropriation of September 19, 1890, be expended in constructing a jetty of rough stone dumped in place in the location indicated in red and lettered A. The location in black has simply been used as a study and is considered less suitable than the two in red.

The work should be commenced at the shore and be raised at first to low water only in order to cover the entire length if practicable.

After both jetties have been built as high as low water, they may be raised to half-tide level 6 feet above low water if found necessary.

Suitable stone is found at convenient quarries in the vicinity.

The estimated cost of the jetty if raised to half-tide level and made 10 feet wide on top is 70,000 tons rough stone, at 60 cents per ton	$42,000
Contingencies of engineering, etc	4,200
Total	46,200

The tonnage of the Penobscot River is very large, being more than 2,000,000 tons annually, which is exceeded by but very few rivers in the United States. The places here discussed are the most important ones on the river, and are the only ones requiring expensive improvements.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., May 18, 1891.

COLONEL: Your project of the 25th ultimo, for expenditure of the $25,000 appropriated by the river and harbor act of September 19, 1890, for improving Penobscot River, Maine, was duly received and referred to The Board of Engineers at New York City for report. It has been received back with indorsement, of which the following is a copy:

[Second indorsement.]

THE BOARD OF ENGINEERS,
ARMY BUILDING,
New York City, May 16, 1891.

Respectfully returned to the Chief of Engineers.

At a meeting of the Board held this date, at which Colonel Smith was present, the following resolution was adopted:

"*Resolved*, That from the reports of Colonel Smith and his verbal statements, it appears that the main shoaling in the section of the river from the mouth of Marsh River to High Head arises from deposits of sawdust, etc., from the mills above. This is contrary to law, and should be stopped under sections 6, 10, and 11 of the river and harbor act of September 19, 1890. It is recommended that steps be taken at once to enforce these provisions of law; and that in the mean time so much of the available funds as are necessary be applied to giving temporary relief by dredging through the shoals on the line of deepest water in the channels now in use."

For the Board:

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Genl., U. S. A.,
President of the Board.

The recommendation of the Board of Engineers is approved.

It is desired that you report fully to this office on the subject of the obstructive deposits of sawdust, etc., in the Penobscot River, giving the names of the parties engaged in the practice, with a view to referring the matter to the Department of Justice for action under the provisions of sections 6 and 10 of the act of September 19, 1890.

By command of Brigadier-General Casey.

Very respectfully, your obedient servant,

H. M. ADAMS,
Major, Corps of Engineers.

Lieut. Col. JARED A. SMITH,
Corps of Engineers.

In compliance with instructions, an employé of this office has visited all mills on the river from Oldtown to Bucksport, and a report has been submitted covering the facts and names of all parties concerned, as nearly as can be ascertained.

Most of the waste comes into the river from points which are not navigable in the usual commercial sense. The material already in the river and tributaries is so great that it may be fairly questioned whether the stopping of further deposits and a temporary relief by dredging will result in an immediate and permanent improvement through the natural action of the river itself.

The dredging of the channel at High Head will be undertaken as soon as arrangements therefor can be conveniently made.

An attempt has been made to obtain statistics of the tonnage in freights on the Penobscot River, but it is apparent that in many cases the information received is neither reliable nor complete. It is probable that the amount of 2,165,092 tons given in last year's report for year 1886 is a fair estimate of the freights annually carried.

Bangor, at head of navigation, is a port of entry.
Fort Knox, is at the narrows opposite Bucksport.

Money statement.

July 1, 1890, balance unexpended		$27,243.87
Amount appropriated by act approved September 19, 1890		25,000.00
		52,243.87
June 30, 1891, amount expended during fiscal year		22,659.89
July 1, 1891, balance unexpended		29,583.98
July 1, 1891, outstanding liabilities	$1,710.08	
July 1, 1891, amount covered by uncompleted contracts	2,829.60	
		4,539.68
July 1, 1891, balance available		25,044.30
Amount (estimated) required for completion of existing project		330,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

Imports.	Tons.	Exports.	Tons.
Flour, grain, etc	32,372	Ice	435,000
Coal	147,260	Lumber	413,333
Lime and cement	3,394	Granite, slate, etc	32,093
Lumber (pine)	766	Bricks	17,000
Kerosene	3,010	Iron (pig)	1,800
Salt	2,039	Wood, hay, potatoes	27,290
Iron, nails, castings, etc	3,660	Miscellaneous	113,005
Miscellaneous	122,537		
Total	315,038	Total	1,039,521

Total tonnage reported, 1,354,559. The above freights have been reported as carried in vessels; in addition to this a large amount of lumber is towed in rafts.

The following commercial statistics for the fiscal year ending June 30, 1891, were furnished by the United States collector of customs for the Bangor district, which includes the river from Bangor to Winterport:

Shipping.	No.	Tonnage.
Arrivals from foreign countries	13	3,459.00
Clearances for foreign countries	44	19,095.00
Vessels built in district	4	1,291.30

Value of imports	$1,255,741.00
Value of exports	215,000.00
Amount of duties collected	238,818,78

A 9.

IMPROVEMENT OF BELFAST HARBOR, MAINE.

The river and harbor act of August 11, 1888, required an examination or survey of this harbor. Reports of the examination and survey were submitted and printed in House Ex. Doc. No. 81, Fifty-first Congress, first session; also in Report of Chief of Engineers, 1890, page 455.

The project adopted for the improvement is—

1. To dredge channel from deep water to upper harbor, 220 feet wide and 15 feet deep at mean low water, 70,324 cubic yards, in scows, at 20 cents per cubic yard	$14,064.80
2. To dredge area on northeast side of harbor to depth of 8 feet at mean low water, 50,521 cubic yards, at 20 cents	10,104.20
3. To dredge area on west side of harbor to a depth of 13 feet at mean low water, 111,669 cubic yards, at 20 cents	22,333.80
Engineering expenses and contingencies	5,497.20
Total of estimate	52,000.00

By act of September 19, 1890, Congress appropriated $10,000 to commence the improvement. This work has been combined with the Narraguagus River, Camden and Rockport Harbors, in a single contract, as all the works are small, of the same character, and not widely separated. The prices thus obtained are lower than could otherwise have been anticipated.

Dredging under the contract was commenced June 18, 1890.

Amount dredged in June, 11,007 cubic yards.

It is expected that the dredging will be completed as far as may be done with available funds before the close of summer.

The latest commercial statistics reported are included in Report of Chief of Engineers for 1888, pages 383 and 384.

The freight tonnage imports and exports was then indicated to be 354,000 tons.

Belfast is in the collection district of Belfast. The nearest light-house is Dice Head, near Castine.

Money statement.

July 1, 1890, balance unexpended		$1,985.99
Amount appropriated by act approved September 19, 1890		10,000.00
		11,985.99
June 30, 1891, amount expended during fiscal year		574.94
July 1, 1891, balance unexpended		11,411.05
July 1, 1891, outstanding liabilities	$1,823.38	
July 1, 1891, amount covered by uncompleted contracts	9,136.34	
		10,959.72
July 1, 1891, balance available		451.33

Amount (estimated) required for completion of existing project.....	$42,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	42,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

NOTE.—For abstract of proposals see the abstract of proposals appended to the report for Narraguagus River, Maine.

COMMERCIAL STATISTICS.

The following commercial statistics were furnished by the United States deputy collector of customs at Belfast, Me., for fiscal year ending June 30, 1891:

Shipping.		No.	Tonnage.
Arrivals from foreign ports		112	9,212.00
Clearances for foreign ports		102	9,246.00
Vessels built:			
1 ship	1,788.15		
1 barkentine	835.41		
10 schooners	8,061.90		
2 sloops	19.03		
—		14	10,704.49

Value of exports to foreign ports	$15,089
Value of imports from foreign ports	20,929

No record is kept of coastwise vessels.
Estimated tonnage of the harbor, 354,000 tons.

A 10.

IMPROVEMENT OF HARBOR AT CAMDEN, MAINE.

This harbor was so shoal that at low water vessels drawing more than 6 feet could not reach the wharves.

The project of improvement adopted in 1888 is as follows:

(1) Dredging approaches to depth of 12 feet.
(2) Dredging channels to depth of 10 feet.
(3) Removing Middle Ground to depth of 10 feet.

The amount expended previous to June 30, 1890, was $4,968.67.

Expended in last fiscal year, $62.50.

As a result the west channel had been dredged to a depth of 10 feet at low water over a distance of 1,150 feet and a width of 75 feet, and an additional distance to same grade and a width of 50 feet.

This assists somewhat in reaching the wharves, but is not a radical improvement.

Under the appropriation of $6,000 by act of September 19, 1890, a contract has been let in connection with the works at Rockport and Belfast Harbors, and the Narraguagus River. The contract was let to the bidder whose proposal in the aggregate was the lowest. By this means the prices for each work will doubtless be less than they would be if let separately. Under a single appropriation of $5,000 the contract price paid was 25 cents per yard. By combining it with three other works in one contract the price has been reduced to 18 cents per yard.

Dredging under the contract will be undertaken and probably completed before the close of the present season. The work will consist of widening the channel formerly dredged.

The small expenditures of the last fiscal year have been for advertising and other necessary contingencies.

It has not been practicable to obtain any complete statistics of freights at Camden Harbor.

Camden is in the collection district of Belfast. The nearest light-house is on Negro Island, at entrance to harbor.

Money statement.

July 1, 1890, balance unexpended	$31.33
Amount appropriated by act approved September 19, 1890	6,000.00
	6,031.33
June 30, 1891, amount expended during fiscal year	62.50
July 1, 1891, balance unexpended	5,968.83
July 1, 1891, amount covered by uncompleted contracts	5,428.00
July 1, 1891, balance available	540.83
Amount (estimated) required for completion of existing project	49,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	49,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

NOTE.—For abstract of proposals see the abstract of proposals appended to the report for Narraguagus River, Maine.

A 11.

IMPROVEMENT OF HARBOR AT ROCKPORT, MAINE.

This harbor is upon the west side of Penobscot Bay, about 6½ miles north of Rockland. It is open on the south, and has ample depth of water except near the wharves at the upper or northern limit.

The obstructions are from the shallow water near the wharves and from ice in winter, the ice being doubtless made worse by the shallow water.

The project of improvement is to deepen the part near the upper wharves to 12 feet at mean low water.

Previous to June 30, 1890, the amount expended was $9,986.81.

Amount expended in last fiscal year $102.

As a result, more than two-thirds of the area included in the project has been dredged to a depth of 12 feet at mean low water.

There remains to complete the project the removal of about 45 cubic yards of ledge and a small amount of dredging.

Under the appropriation of $5,000 by act of September 19, 1890, a contract has been made for dredging and removing the rock in connection with similar work at Camden and Belfast Harbors, and the Narraguagus River. By this method the amount of the contract was increased, and the prices are doubtless less than could be obtained in letting the work by itself.

Work under the contract will be completed, thus completing the improvement, before the close of the year 1891.

Rockport is an important harbor for ship building, manufacture and shipment of lime, and also of ice.

It has not been practicable to obtain complete statistics of the commerce for the last year.

Rockport is in the collection district of Belfast. The nearest light-house is on Indian Island at entrance to harbor.

Money statement.

July 1, 1890, balance unexpended	$13.19
Amount appropriated by act approved September 19, 1890	5,000.00
	5,013.19
June 30, 1891, amount expended during fiscal year	102.00
July 1, 1891, balance unexpended	4,911.19
July 1, 1891, amount covered by uncompleted contracts	4,510.00
July 1, 1891, balance available	401.19

NOTE.—For abstract of proposals see the abstract of proposals appended to the report for Narraguagus River, Me.

A 12.

IMPROVEMENT OF HARBOR AT ROCKLAND, MAINE.

This harbor is so located as to form a convenient refuge for large numbers of coasting vessels. It is in the southwest part of Penobscot Bay. The anchorage is good, but was originally exposed to all easterly storms.

The project as modified and now adopted, for reasons set forth in last Annual Report, is for a breakwater from Jameson Point.

The outer end of breakwater is planned to be at a distance of 3,940 feet from low-water mark on shore. The old part on the shore end is to be raised to high-water level and have a width of 10 feet on top, as far as can be done with the material already there; the stone is to be removed from the shore end, and be used to continue the work inward to its full height. This will leave a small interval next the shore through which small boats may pass at low water, and large craft at high water without the necessity of passing around the end of the breakwater.

The estimated expense of entire work was $712,500.

Expenditures on the breakwater to June 30, 1890, were	$152,500.00
Expenditures in last fiscal year	3,152.27
Total	155,652.27

Under the appropriation of September 19, 1890, a contract has been made, after public advertising for proposals.

The lowest bidder was W. S. White, Rockland, Me., and the contract has been made with him to deliver stone in the breakwater at 78½ cents per ton, and to remodel the old part at 98½ cents per ton.

The first stone under the contract was delivered May 25.

The amount delivered to the end of June is 2,762¾ tons.

Rockland is an important commercial point, and the harbor furnishes a refuge for many coasting vessels in storms.

The completion of the project will result in a great benefit to the local and coasting navigation.

Money statement.

Amount appropriated by act approved September 19, 1890		$37,500.00
June 30, 1891, amount expended during fiscal year		558.51
July 1, 1891, balance unexpended		36,941.49
July 1, 1891, outstanding liabilities	$2,593.76	
July 1, 1891, amount covered by uncompleted contracts	31,581.24	
		34,175.00
July 1, 1891, balance available		2,766.49

Amount (estimated) required for completion of existing project.....$442,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for construction of breakwater at Rockland, Me., opened December 2, 1890.

No.	Name and address of bidder.	Price per ton of 2,000 pounds.	
		For stone furnished and delivered in the breakwater.	For taking up and relaying 2,200 tons stone at shore end of the breakwater.
		Cents.	*Cents.*
1	W. S. White, Rockland, Me	78½	98½
2	Bodwell Granite Company, Rockland, Me	85	98
3	John F. Hamilton, Portland, Me	81	65
4	Wm. P. Hurley, Rockland, Me	80	81
5	Thomas A. Rowe, Boston, Mass	97	65

W. S. White, Rockland, Me., was the lowest bidder in the aggregate. The contract was awarded to him.

COMMERCIAL STATISTICS.

Imports.	Tons.	Exports.	Tons.
Wood and cooperage	71,950	Lime	150,000
Coal	29,455	Ice	5,500
Granite	54,200	Salt	260
Lumber and timber	21,294	Coal	1,750
Salt and fish	2,106	Lumber	1,940
Brick, cement, and sand	3,709	Miscellaneous	28,381
Flour and grain	5,084		
Miscellaneous	35,937		
Total	223,735	Total	187,831

Total tonnage of freights, 411,566.
Arrivals of sailing vessels, 3,024.
Arrivals of steam vessels, 1,573.
Total tonnage, arrivals and departures, 2,079,806.
Number of vessels visiting harbor for anchorage estimated from 4,000 to 5,000.

A 13.

IMPROVEMENT OF KENNEBEC RIVER, MAINE.

The navigation of the river has been much obstructed by shoals from Augusta to Gardiner and a few points below; also by a ledge of rock at Lovejoy Narrows.

The project for improvement consists in removing the shoals at Beef Rock, Hatch Rock, and South Gardiner by wing dams, training walls,

and dredging, removing other shoals by dredging only, removing ledges by usual methods of blasting, and removing old bridge piers at Hallowell.

The estimated cost of improvement did not include the expense of dredging where training walls are to be used, as it was hoped the expense might be avoided. (See Report of Chief Engineers, 1888, page 420.)

The appropriations were not sufficient to complete the contraction works at Beef Rock Shoal and Hatch Rock Shoal in a single contract, so that the time has been greatly prolonged, and dredging has been necessary to avoid temporary inconvenience to the shipping. The cost of dredging at these places is therefore added to the estimated cost of the entire project.

Estimated cost of improvement	$428,500.00
Amount appropriated previous to June 30, 1891	125,000.00
Amount expended to June 30, 1891	123,650.12

At the beginning of the fiscal year contraction works at Beef Rock and Hatch Rock shoals were being constructed under contract previously reported. (See map opposite page 442, Report, Chief of Engineers, 1890.)

Work under the contract was completed September 30, owing to the entire expenditure of the appropriation under which the contract was made.

In the months of July, August, and September the amount of material placed in the work was 14,335 tons of stone and 2,576 fascines, making a total of 59,915½ tons of stone and 1,476 fascines under the contract.

An opening had been left in the training wall east of Beef Rock in order that vessels might use the old channel as long as possible, as it was somewhat better than the channel which was to be deepened. It was very necessary that the opening should be closed before winter, and also that the jetty and wall should be as nearly complete as possible in order that the spring freshets might be confined in the new channel to produce the required deepening by scour.

The appropriation of September 19, 1890, became available so late that it would have been impracticable to do any work before winter by contract, owing to the loss of time made necessary by advertising and by formalities required by law and regulations. Authority was therefore asked and granted to continue the work in such way as would be most advantageous and economical for the United States, providing the prices did not exceed those paid under previous contract.

An agreement was therefore made with the parties who had been superintending work under the previous contract to continue it expeditiously upon the same terms as before.

Under this agreement the work was continued until November 8, when it was suspended.

The material placed in the work from October 1 to November 8, inclusive, was 3,486 tons of stone and 1,775 fascines.

The progress made was very unsatisfactory, and steps were therefore immediately taken to procure stone, and put it in place by dropping it through holes cut in the ice. On the 1st of January, 1891, operations were commenced.

Stone was purchased from farmers and others living in the vicinity who hauled it on sleds upon the ice and dropped it through holes cut on the alignment of the wall.

Operations were suspended March 19, owing to the condition of the ice. The amount of stone thus put in was 21,663¼ tons, and the average price paid was 67$\frac{63}{100}$ cents per ton. The price paid under the contract which had been let to the lowest bidder after public advertisement was 99½ cents per ton. It may be added that the work thus done is in no way inferior to that done by contract, and it was accomplished so much more rapidly that the contingencies ofs uperintendence, etc., were reduced more than one-half.

The contraction works at Hatch Rock Shoal were entirely completed in the summer of 1890. At Beef Rock Shoal the jetty has been completed from Green Point across the flats to the edge of channel a distance of 2,800 feet. From that point the training wall has been completed to full height a distance of 4,000 feet, except 300 feet, where the opening was left and which is raised to low-water level. An additional distance of 730 feet at the lower end has been raised to low-water level.

One thousand and thirty feet of the training wall remains to be raised from low-water level to high-water level, a height of 5 feet, and 170 feet at the lower end is yet to be built entire. Two hundred fascines have been purchased and stored for use in continuing the foundation of the wall.

The spring freshets caused a very strong current through the channel thus contracted, and the nearly clean sand of the bottom was driven along until the end of the incomplete work was passed, where the somewhat slackened current was not sufficient to continue the movement to such a degree as to deepen the water at that place. In anticipation of such a result, and in order as far as possible to avoid any inconvenience to shipping, a dredge was employed to deepen the channel over the shoalest part.

Dredging was commenced October 15 and continued until compelled to suspend, November 24, owing to the cold and ice. Dredging was resumed April 27, 1891, and continued until May 26. The channel dredged is 150 feet wide and not less than 12 feet deep at low water.

The former channel did not exceed 10 feet at the shoalest place. At Hatch Rock Shoal the effect of the contraction works was to increase the depth of water in the channel at least 1½ feet.

The down stream movement of the sand which had drifted out of the contracted place by the increased current was too slow to produce the immediate benefit which was desired. The dredge was therefore employed from May 27 to June 10, inclusive, dredging to a depth of 9 feet.

Amounts dredged were as follows:

	Cubic yards.
At Beef Rock Shoal	53,317
At Hatch Rock Shoal	11,379
Total	64,696

The cost of dredging was 25 cents per cubic yard.

As a result the channels are at least 2 feet deeper than before the improvements were commenced, and the completion of the work will, without doubt, make the improvement permanent.

A further increase of depth is anticipated at Beef Rock when the training wall shall be completed.

During the year two surveys of these channels were made to afford data for studying and carrying on the improvement.

In the spring of 1891 questions arose which made the establishment of harbor lines necessary on the river adjacent to the city of Bath.

For this purpose a complete survey of the harbor front, with sound-

ings as far out as the contour of 25 feet depth, was made in May and June, 1891. The map has been plotted, but a pressure of other matters has prevented the entire completion of the work.

In November, 1890, proposals for removing three piers of the old bridge at Hallowell were invited by public advertisement. Bids were opened December 2, 1890, and a contract was awarded to Messrs. Jordan & Carlton, of Woolwich, Me., the lowest bidders, at a price of $2,423 for the entire work. Operations were commenced May 25, 1891, and continued to the end of the fiscal year. As the work is yet incomplete, no payments have been made.

The contract requires the entire removal of the piers on or before August 1, 1891. It has not been practicable to obtain complete statistics for the last year.

The freights upon the Kennebec River are very large, being according to the latest statistics in excess of 2,500,000 tons per year, in addition to which is a vast amount of lumber in rafts which does not show in the freight statistics.

The improvement is in the collection district of Bath, of which Bath is the port of entry. Fort Popham and the light-house on Pond Island are near the mouth of the river.

Money statement.

July 1, 1890, balance unexpended		$28,859.28
Amount appropriated by act approved September 19, 1890		50,000.00
		78,859.28
June 30, 1891, amount expended during fiscal year		63,890.71
July 1, 1891, balance unexpended		14,968.57
July 1, 1891, outstanding liabilities	$3,618.69	
July 1, 1891, amount covered by uncompleted contracts	2,423.00	
		6,041.69
July 1, 1891, balance available		8,926.88
Amount (estimated) required for completion of existing project		303,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		303,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for removing old bridge piers in the Kennebec River at Hallowell, Maine, opened December 2, 1890.

No.	Name and address of bidder.	Gross price to cover all expense of removing old piers.
1	Joseph F. Curit and Isaac H. Webber, Chebeague, Me	$3,000
2	George W. Townsend, Boston, Mass	4,349
3	John F. Hamilton, Portland, Me	2,699
4	Samuel S. Jordan, Bath, Me., and F. W. Carleton, Woolwich, Me	2,423
5	L. E. Lunt & Co., Portland, Me	4,400

The contract was awarded to Jordan & Carleton, Bath, Me.

COMMERCIAL STATISTICS.

Shipping.	Number.	Tonnage.
Vessels built at Bath:		
Ships	3	8,634.85
Barks	3	2,712.43
Steamers	2	4,168.67
Schooners	35	22,512.29
Sloop	1	24.05
Total	44	38,052.29

Vessels entered from foreign ports	127
Vessels cleared for foreign ports	5
Vessels entered from domestic ports	65
Vessels cleared for domestic ports	9
Coastwise vessels (estimated)	5,500

No record is kept of coastwise vessels.
This does not include the daily lines of steamers.

Value of imports	$63,900

Value of articles shipped in sailing vessels.

	Tons.	Value.
Ice	1,000,000	$3,000,000
Lumber	201,894	797,285
Hay	8,500	102,000
	1,210,394	3,899,285

The above statistics for fiscal year ending June 30, 1891, were furnished by the the United States deputy collector of customs for the Bath district.

Estimated tonnage of the entire river.

	Tons.
By sailing vessels	2,082,000
By steamers	434,000
Total	2,516,000

A 14.

IMPROVEMENT OF HARRASEEKET RIVER, MAINE.

In compliance with requirement of section 13 of the river and harbor act of August 11, 1888, an examination of this river was made and an estimate of the cost of an improvement was submitted by the officer in charge of the work. See Report of Chief of Engineers, 1889, page 550.

The project is to obtain a channel 60 feet wide and 14 feet deep at mean high water by dredging.

The estimated cost of the improvement is $36,000. Congress appropriated $10,000 for the work by act of September 19, 1890.

This amount can not be expended in such a manner as to produce any benefit by itself.

It has therefore been considered best to withhold the expenditure until it may be made in connection with a further appropriation.

The river is in the collection district of Portland and Falmouth. The nearest lighthouse is on Half Way Rock.

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000.00
July 1, 1891, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	26,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	26,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

There are no commercial statistics to report.

The probable commerce is dependent upon the improvement of the channel.

A 15.

IMPROVEMENT OF PORTLAND HARBOR, MAINE.

The project of this improvement consists in dredging a channel 500 feet wide and 29 feet deep at mean low water, from deep water of the anchorage to the lower part of the harbor, where the largest steamers and other vessels receive and discharge cargoes, and to deepen the water front in the upper part of the harbor to 16 feet.

The entire cost of the project is estimated to be $140,000.

Amount appropriated to June 30, 1891, $110,000.

Amount expended to June 30, 1891, $68,883.35.

Congress having appropriated $40,000 by act of September 19, 1890, proposals for dredging to widen the channel were invited by public advertisment dated January 15, 1891. Bids were received and opened February 10. The lowest bidder was the firm of Moore & Wright, of Portland, Me., the price being 19 cents for hard material and 9½ cents for soft.

In order to obtain all possible competition for the dredging, the contractor was allowed to do the work at any time previous to November 30, 1892, but the actual working time allowed is but eight months.

Dredging will probably be commenced before the close of the season of 1891.

The work accomplished under previous appropriations is indicated on page 444 of Report of Chief of Engineers for 1890.

The completion of the project will be of great advantage to the large vessels, though they can now enter and leave at all stages of the tide by exercising care.

The harbor is defended by Forts Preble, Gorges, Scammel, and a battery at Portland Head.

There is a light-house on the breakwater, and a second at Portland Head, 3 miles distant from the city.

The harbor is in the collection district of Portland and Falmouth, Me., of which Portland is the port of entry.

Money statement.

July 1, 1890, balance unexpended	$1,691.77
Amount appropriated by act approved September 19, 1890	40,000.00
	41,691.77
June 30, 1891, amount expended during fiscal year	575.12
July 1, 1891, balance unexpended	41,116.65
July 1, 1891, amount covered by uncompleted contracts	37,237.60
July 1, 1891, balance available	3,879.05

Amount (estimated) required for completion of existing project.....	$30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Portland Harbor, Maine, opened February 10, 1891.

No.	Name and address of bidder.	Price per cubic yard in situ.	
		Area No. 1, hard dredging.	Area No. 2, soft dredging.
		Cents.	*Cents.*
1	National Dredging Company, Wilmington, Del	26	13
2	Edward Moore and A. R. Wright, Portland, Me	19	9⅓
3	A. K. Stone, Roxbury, Mass	25	15

The contract was awarded to Moore and Wright, Portland, Me.

COMMERCIAL STATISTICS.

The following statistics for the year ending June 30, 1890, were furnished by the collector of customs:

Shipping.	No.	Tonnage.
Vessels arrived	594	516,718
Vessels cleared	552	501,265
Vessels built	10	549,895

Value of imports	$9,905,895
Value of exports	11,849.434

No record has been kept of arrivals and departures coastwise.

The harbor is used as a refuge for a very large number of vessels of all classes which are not reported. The number at times amounts to several hundred.

The following commercial statistics for fiscal year ending June 30, 1891, compiled from records kept by the board of trade, and from various other sources, are necessarily incomplete.

Imports.	Tons.	Exports.	Tons.
Coal	450,000	Lumber	112,636
Iron	2,100	Flour and grain	100,530
Molasses and sugars	51,638	Bacon, pork, lard, etc	7,227
Salt	13,586	Ice	30,000
Lumber	78,174	Fish	12,150
Rags	3,706	Apples	7,400
Miscellaneous	109,453	Miscellaneous	100,116
Total	708,657	Total	370,059

Arrivals of sailing vessels	2,115
Arrivals of steamers	732

This does not include the large number of small steamers which ply from point to point among the islands in Casco Bay.

Total tonnage of Portland Harbor (estimated), 2,655,500 tons.

A 16.

IMPROVEMENT OF CHANNEL IN BACK COVE, PORTLAND, MAINE.

The project for this improvement, adopted in 1886, is to deepen and straighten the channel so that it shall follow the harbor commissioners' line; have a width of 300 feet and a depth of 12 feet at mean low water.

The total cost of the improvement was estimated at $180,000.

Appropriations have been made for this improvement amounting to $76,250.

The total expenditures to June 30, 1891, have been $51,634.31.

The channel thus far dredged to grade has a length of 4,050 feet and a width of 90 feet on the bottom. In addition to the general width the upper end of channel is widened to make a turning basin 400 feet wide and an average length of 320 feet.

Owing to lack of funds no work of improvement has been carried on during the last year. A survey of a part of the channel has been made and the work plotted.

The expenditures of the last year have been for this survey and for advertising and other contingent work, preparatory to resuming operations under contract.

Congress having appropriated $25,000 by act of September 19, 1890, for continuing the improvement, proposals for dredging were invited by public advertisment dated January 15, 1891.

Bids were received and opened on the 10th of February.

The National Dredging Company of Wilmington, Del., was the lowest bidder, and the contract was accordingly awarded at the price of 11 cents per cubic yard.

It should be remembered that this price for the work, as well as for dredging elsewhere in this district, has been exceptionally low. These low prices are not due to any reduced expense of dredging, nor to any ordinary competition, but rather to the methods employed to force a union or combination among contractors for this class of work. The prices therefore do not form any reliable basis for future estimates of the cost of works to be done by contract.

In order to obtain as wide a competition as possible, the contractor was allowed until November 30, 1892, to complete the dredging as far as funds now available may permit.

The time allowed in which to do the work is 6 months.

It is not expected that dredging will be commenced until the season of 1892.

The improvement thus far has resulted in a large increase of business and values in the vicinity of the channel.

Back Cove is a part of Portland Harbor, and is therefore in the same collection district, and is defended by the same forts, and is near the same light-houses as are given for Portland Harbor.

Money statement.

July 1, 1890, balance unexpended	$275.60
Amount appropriated by act approved September 19, 1890	25,000.00
	25,275.60
June 30, 1891, amount expended during fiscal year	659.91
July 1, 1891, balance unexpended	24,615.69
July 1, 1891, amount covered by uncompleted contracts	22,500.00
July 1, 1891, balance available	2,115.69

Amount (estimated) required for completion of existing project.....$103,750.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Back Cove, Portland Harbor, Maine, opened February 10, 1891.

No.	Name and address of bidder.	Price per cubic yard for material measured in scows.
		Cents.
1	Charles H. Souther, Boston, Mass	20
2	Robert Hamilton, Chebeague, Me., and Solomon Sawyer, Yarmouth, Me	20½
3	A. K. Stone, Roxbury, Mass	21
4	National Dredging Company, Wilmington, Del	11
5	Edward Moore and Augustus R. Wright, Portland, Me	11½

The contract was awarded to the National Dredging Company, Wilmington, Del.

COMMERCIAL STATISTICS.

The following statistics were courteously furnished by Messrs. Winslow & Co.:

Receipts by water in 1890.

Articles.	Tons.
Coal	9,552
Clay	12,223
Sand	306
Total	22,051

Total receipts by water in 1889	tons	13,055
Increase	do	8,996
Number of vessels passing through channel—		
In 1889		36
In 1890		63

A 17.

BREAKWATER AT MOUTH OF SACO RIVER, MAINE.

The present project for this improvement consists in repairing and completing the old breakwater, so that it shall have a height of 15 feet above low water and a width of 12 feet on top.

Estimated cost of improvement was $72,000.

Amount of appropriations to June 30, 1891, $40,000.

Expenditures to same date, $40,000.

At the beginning of the year the breakwater was being enlarged and repaired under a contract previously reported. The work was completed July 31, as far as available funds would permit.

During the month of July the amount of stone placed on the breakwater was 1,950 tons, making a total of 12,084 under the contract.

The breakwater has now been raised to its full height a distance of 2,320 feet from the end, and partially raised a further distance of 28 feet.

The completion of the breakwater is desirable, though at present of less importance than the jetty on opposite side of the channel.

The end of breakwater nearest the shore serves mainly to stop the drifting of sand into the channel; the work being a pile of stone dumped in place, a large amount of sand is driven through the breakwater into the channel. It therefore seems probable that some other method of stopping the drifting sand may be made more effective than by merely adding stone to the height and width. Until some other method may be decided upon, however, the balance of $30,000 originally estimated to complete the breakwater will be considered as the estimate for completion.

By act of September 19, 1890, Congress made an appropriation for the Saco River improvement, including the breakwater. The estimate for completion of breakwater has, therefore, been added to the estimate for completing project on the river before the breakwater was included.

Money statement.

July 1, 1890, balance unexpended	$4,872.81
June 30, 1891, amount expended during fiscal year	4,872.81

A 18.

IMPROVEMENT OF SACO RIVER, MAINE.

The project for improving the Saco River includes the contraction works, removal of ledge, and dredging, considered necessary to give a channel having not less than 6 feet depth at low water from the sea to the cities of Saco and Biddeford.

The project also includes the breakwater, which had been treated as a separate work until the act of September 19, 1890, which included both the river and breakwater in one appropriation. For further explanation see report on Saco River Breakwater.

At the beginning of the fiscal year work was in progress upon the wing dam and training wall at Little Islands and upon the wing dam and bank protection at Cow Island.

Delivery of stone under the contract was completed August 6.

The amount of stone put in the works subsequent to June 30 was 1,180½ tons, and the total under the contract was 9,006½ tons.

The jetty and wall at Little Islands, 750 feet long, has been completed, and the contraction of the channel at that place has caused a very satisfactory scour of the sand, so that the channel is much improved.

The effect of this jetty has been so great in moving the sand that should a deeper channel be required than is now given over the ledge between the islands, it is very evident that it may be easily obtained outside the islands merely by contracting the width. It has been ascertained that the obstruction there is all loose sand.

By act of September 19, 1890, Congress appropriated $65,000 for continuing the improvement, including the breakwater at the mouth of the river.

The jetty opposite the breakwater is considered much the most important part of the improvement at present. The project for work under that appropriation has therefore been limited to the jetty and to small spurs should they be required.

Under date of December 13, 1890, proposals were invited for placing stone in the jetty and spurs. Bids were opened December 31, 1890, and the contract was awarded to Mr. George Willett Andrews, of Biddeford, who was the lowest bidder. The price of rough stone delivered in place is 84 cents per ton.

Delivery of stone in the jetty was commenced April 9, 1891. At the end of the fiscal year the amount delivered was 8,626 tons.

The amount constructed thus far is insufficient to cause any radical effect.

The navigation on the river varies from year to year. In the last year the tonnage statistics were less than the year previous. Probably the mean tonnage for the 2 years would fairly represent the average.

Saco River is in the collection district of Saco, Me., of which Saco is the port of entry. Nearest light-house, Wood Island.

Money statement.

July 1, 1890, balance unexpended		$2,353.46
Amount appropriated by act approved September 19, 1890		65,000.00
		67,353.46
June 30, 1891, amount expended during fiscal year		6,683.18
July 1, 1891, balance unexpended		60,670.28
July 1, 1891, outstanding liabilities	$3,969.51	
July 1, 1891, amount covered by uncompleted contracts	50,652.72	
		54,622.23
July 1, 1891, balance available		6,048.05
Amount (estimated) required for completion of existing project		97,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for construction of stone jetty at the mouth of the Saco River, Maine, opened December 31, 1890.

No.	Name and address of bidder.	Price.*
		Cents.
1...	John F. Hamilton, Portland, Me., and Isaac H. Webber, Chebeague, Me	97
2...	George Willett Andrews, Biddeford, Me	84

* Per ton of 2,000 pounds for stone furnished and delivered in the jetty.

The contract was awarded to George Willett Andrews, Biddeford, Me.

COMMERCIAL STATISTICS.

Exports.	Tons.	Imports.	Tons.
Sand	565	Coal	33,015
Ice	1,212	Lumber	738
Bricks	6,160	Iron	1,384
Granite	75	Lime and cement	938
Total	8,012	Total	36,075

Total tonnage of river in 1890	44,087
Total tonnage of river in 1889	114,945½
Decrease	70,058½
Number of arrivals in the river	170

These vessels are mostly schooners drawing from 8 to 12 feet.

A 19.

IMPROVEMENT OF KENNEBUNK RIVER, MAINE.

In compliance with requirement of the river and harbor act of August 11, 1888, an examination and survey was made of part of the river and an estimate was submitted for repairing the stone jetties at the mouth of the river and the old wooden pier a few hundred feet above, also of constructing a small jetty of rough stone to contract the channel at a place known as "The Wading Place."

The entire estimated cost was $20,000. (Ex. Doc. No. 136, H. R., Fifty-first Congress, first session; also Report of Chief of Engineers 1890, pages 471 to 474.)

By the river and harbor act of September 19, 1890, Congress appropriated $20,000 to complete the improvement.

The repairs of the piers were of a kind which could not be advantageously done by contract. The officer in charge of the work therefore submitted a recommendation that the improvement be carried on by hired labor and purchases in open market as the most economical and advantageous to the Government. This recommendation was approved.

The work of repair upon the piers and wharf was commenced May 24, and has been carried on continuously.

The work accomplished thus far is not of a kind to be definitely given in any units of measure. The repairs upon stone piers are well advanced, and the wooden pier has been torn out for a distance of 130 feet from upper end. It is expected that the amount now available will be sufficient to complete the improvement.

The freights upon the river are small, but the place is of considerable importance for yachts and other pleasure craft.

The river is in the collection district of Kennebunk; nearest port of entry is Kennebunk; nearest light-house is on Goat Island near Cape Porpoise.

Money statement.

Amount appropriated by act approved September 19, 1890	$20,000.00
June 30, 1891, amount expended during fiscal year	667.76
July 1, 1891, balance unexpended	19,332.24
July 1, 1891, outstanding liabilities	922.81
July 1, 1891, balance available	18,409.43

COMMERCIAL STATISTICS.

Receipts by water:	Tons.
Coal	2,166
Lumber	1,814
Total tonnage of freight	3,980

Shipping.	Number.	Tonnage.
Arrivals of sailing vessels	14	2,629.97
Vessels built during year	4	3,510.47

The above statistics for year ending June 30, 1891, were furnished by the collector of customs.

NOTE.—The place is also visited by numerous steam tugs, small sailing vessels, and pleasure craft.

A 20.

IMPROVEMENT OF HARBOR AT YORK, MAINE.

The entrance to this harbor is in a narrow bend where the channel between the contours of 10 feet at mean low water was not more than 75 feet wide.

Two other points above the narrows are also in bends where the channel is narrow, and at all the points the tidal currents are very rapid.

The object of the project for improvement is to give greater width at the narrow points and to somewhat reduce the effect of the strong currents.

The estimated cost, $44,000.

Amount appropriated, $35,000.

Expenditures to June 30, 1891, $34,833.90.

At the beginning of the fiscal year rock was being removed from the point of Stage Neck under a contract previously reported. The work was very difficult and progressed slowly. The time for completion was, therefore, extended upon request of the contractor to June 30, 1891.

Notwithstanding the cold of winter in this latitude, the work was carried on continuously until February 25, 1891, when it was completed as far as could be done under the terms of the contract.

The amount of material removed after July 1 was 760.3 cubic yards of ledge and 2 cubic yards of bowlders. The total removed under the contract was 975 cubic yards of ledge and 1,212.1 cubic yards of bowlders and gravel.

Under the appropriation of September 19, 1890, proposals for removing ledge were invited by public advertisement dated January 15, 1891.

Bids were opened February 10, 1891, and a contract for continuing the work as far as could be done with the available funds was awarded to Mr. Thomas Symonds, of Leominster, Mass., who was the lowest bidder. The price for removing ledge was $13 per cubic yard, measured in scows.

The first material under the new contract was removed March 7, 1891, although the drilling and blasting had been commenced February 26. Work under this contract was continued until June 30, 1891, when it was completed.

The amount of ledge removed under this contract was 690.7 cubic yards.

There remains of the ledge at Stage Neck to be removed under the project a piece about 15 feet wide and 125 feet long.

With the small appropriations made heretofore, prices have ranged high and contingent expenses have been much larger than would obtain with larger contracts.

The balance of the estimate is but $9,000, and it is doubtful whether the prices which can be obtained will be low enough to permit the completion of the project.

Whether the project be completed or not, it is believed that the balance of estimate will accomplish all that the situation really demands, so that no modification of estimate is made.

The improvement is in the collection district of York. Nearest light-house is Cape Neddick, 3 miles distant.

Money statement.

July 1, 1890, balance unexpended	$10,727.70
Amount appropriated by act approved September 19, 1890	10,000.00
	20,727.70
June 30, 1891, amount expended during fiscal year	16,700.28
July 1, 1891, balance unexpended	4,027.42
July 1, 1891, outstanding liabilities	3,861.32
July 1, 1891, balance available	166.10
Amount (estimated) required for completion of existing project	9,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	9,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for removing ledge in York Harbor, Maine, opened February 10, 1891.

No.	Name and address of bidder.	Price per cubic yard for material measured in scows.
1	Thomas Symonds, Leominster, Mass	$13.00
2	George W. Townsend, Boston, Mass	14.49
3	Solon S. Andrews, Gorham, Me., and H. H. Sturgis, Bonny Eagle, Me	23.00

The contract was awarded to Thomas Symonds, of Leominster, Mass.

COMMERCIAL STATISTICS.

The following articles were shipped and landed at York, Me., during the year 1890:

	Tons.		Tons.
Brick	6,750	Hay, wood, and potatoes	5,000
Coal	2,000	Merchandise	1,000
Lumber	3,000		
Lime and cement	267	Total tonnage	18,092
Fish	75		

No tonnage having been previously reported, the increase for 1890 can not be given. The vessels in this trade are schooners of about 10 feet draft.

York Harbor being a noted summer resort, many fine vessels of which no record was kept visited it in the yachting season.

A new line of barges between this port and Boston has been established recently by the Piscataqua Company.

A 21.

IMPROVEMENT OF HARBOR AT PORTSMOUTH, NEW HAMPSHIRE.

A project for improving this harbor was adopted in 1879, the object being to give a navigable depth of 20 feet at low water over the ledge known as Gangway Rock, opposite the navy-yard, and to check the strong currents above by the removal of the point of Badger Island.

In addition to the above, the river and harbor act of September 19, 1890, appropriated $13,000 for the removal of a ledge known as Pier Rock.

The expenditures upon the first part of the project to June 30, 1891, have been $114,199.29.

Expenses, advertising, etc., for Pier Rock, $309.09.

The contractor for removing the ledge at Badger Island, mentioned in last annual report, continued work upon the ledge until October 31, when it was suspended for the winter. Operations were resumed in May, 1891, and continued to date.

The amount of ledge removed since July 1, 1890, has been but 244½ cubic yards, making a total of 412 yards under the contract.

The work is very difficult and expensive, owing to the hard rock and very rapid currents.

The completion of work under the contract will accomplish all that is at present contemplated at that place.

Under date of January 15, 1891, proposals were invited by public advertisement for the removal of Pier Rock. Bids were opened on the 10th of February, and the contract was awarded to Mr. Thomas Symonds, of Leominster, Mass., who was the lowest bidder.

The price of removal under this contract is $13 per cubic yard, *in situ*.

Work under this contract will be commenced in July, 1891.

Portsmouth is a port of entry. The light-houses are the harbor light at Fort Constitution and Whale Back, at the entrance.

The defenses of the harbor are all incomplete works: Fort Constitution and an open battery on the west side, and Fort McClary and an open battery on the east side.

The navy-yard at Kittery, Me., is on the east side of the harbor.

Money statement.

July 1, 1890, balance unexpended		$12,114.20
Amount appropriated by act approved September 19, 1890		13,000.00
		25,114.20
June 30, 1891, amount expended during fiscal year		3,965.14
July 1, 1891, balance unexpended		21,149.06
July 1, 1891, outstanding liabilities	$657.44	
July 1, 1891, amount covered by uncompleted contracts	19,350.80	
		20,008.24
July 1, 1891, balance available		1,140.82

Abstract of proposals for removing ledge in Portsmouth Harbor, New Hampshire, opened February 10, 1891.

No.	Name and address of bidder.	Price per cubic yard in situ for removing Pier Rock.
1	Solon S. Andrews, Gorham, Me., and H. H. Sturgis, Bonny Eagle, Me	$17.45
2	George W. Townsend, Boston, Mass	16.97
3	Thomas Symonds, Leominster, Mass	13.00
4	Edward H. French, Fulton, N. Y	21.00

The contract was awarded to Thomas Symonds, Leominster, Mass.

COMMERCIAL STATISTICS.

The following commercial statistics for the year 1890 were courteously furnished by Col. William H. Sise, president of the Board of Trade, Portsmouth, N. H.:

Arrivals of steamers	36
Net tonnage	33,446
Arrivals of sailing vessels	787
Net tonnage	203,634
Arrivals in lower harbor, boarded by United States officer, tonnage not reported	573
Vessels owned in Portsmouth	63
Tonnage of same	10,198.87
Exports—	Tons.
Bricks	36,875
Imports—	
Coal	334,396
Railroad ties	16,348
Lumber	16,196
Lime, cement, and plaster	4,896
Sand	2,247
Stone	1,563
Clay	776
Iron	550
Phosphate	544
Salt	456
Oysters	304
Hay	268
Wood	225
Ashes	225
Total tonnage	419,443

A 22.

IMPROVEMENT OF BELLAMY RIVER, NEW HAMPSHIRE.

The river to the head of navigation is a tidal branch of Great Bay, which opens into the Piscataqua River at Dover Point, 4 miles above the bridge at Portsmouth, N. H.

At low water the channel of the river was too shallow for any navigation save for a short distance. The entire distance over which improvements are required is 13,000 feet, a little more than 2½ miles. The project of improvement consists simply in dredging the present

natural channel sufficiently to give a mean low-water depth of 5 feet and a width of 50 feet on the bottom. The depth at mean high water will be nearly 12 feet.

The improvement commences at a point about 2 miles from the Piscataqua River.

The expenditures to June 30, 1890, were $10,000.

Amount expended in last fiscal year, $111.52.

The expenses of the last fiscal year have been for advertising and other contingencies.

By act of September 19, 1890, Congress appropriated $10,000 for continuing this improvement.

Under date of December, 8, 1890, proposals were invited by public advertisement for dredging to extend the deepening of channel. Bids were opened December 30, 1890, and a contract for the dredging was awarded to Mr. A. B. Martin, of Boston, Mass., who was the lowest bidder. The price of dredging is 25 cents per cubic yard.

Work under the contract is to be completed on or before November 30, 1892.

In a narrow channel like the one in this river, where the depth of excavation is not very large, the dredge, of necessity, removes very much more material than the estimated amounts in situ. The scow measurements, therefore, exceed the situ measurements, not only because the material in scows is less compact, but because more material is actually removed. Ordinarily the excess of scow over situ measurements can be fairly approximated, but in many cases it will exceed the anticipated amount. This has been the case thus far on the Bellamy River, and the situation is such that a large excess can hardly be avoided.

The entire estimated cost was but $28,000, and it is probable that had the entire amount been appropriated in a single sum the consequent reduction in price and in contingent expenses would have been sufficient to offset the increased measurements of material. Under the circumstances, however, it becomes necessary to increase the estimate for completing the work to $15,000.

The partial improvement has been insufficient to develop any considerable change in tonnage or rates of freight.

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	111.52
July 1, 1891, balance unexpended	9,888.48
July 1, 1891, amount covered by uncompleted contracts	9,000.00
July 1, 1891, balance available	888.48
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Bellamy River, New Hampshire, opened December 30, 1890.

No.	Name and address of bidder.	Price per cubic yard for material measured in scows.
		Cents.
1	Charles H. Souther, Boston, Mass	34½
2	George Thomas Symonds, Kittery Point, Me George Walter Todd, Leominster, Mass	29 9/10
3	Boynton Bros., Boston, Mass	30
4	Andrew K. Stone, Roxbury, Mass	36
5	Augustus R. Wright, Portland, Me	28
6	A. B. Martin, Boston, Mass	25
7	Robert Hamilton, Chebeague, Me Solomon Sawyer, Yarmouth, Me	31

The contract was awarded to A. B. Martin, Boston, Mass.

COMMERCIAL STATISTICS.

The tonnage before the improvement was commenced was given as 7,500 tons.

The improvement has not been sufficiently extended to develop any perceptible change.

A 23.

IMPROVEMENT OF COCHECO RIVER, NEW HAMPSHIRE.

For a description of this river and its connections see Report of Chief of Engineers, 1887, page 548. Also see annual report of Chief of Engineers for 1890.

Under the provisions of section 13 of the river and harbor act of August 11, 1888, an examination and survey of the river was made from Dover to its confluence with the Salmon Falls River, where the two form the Piscataqua.

The officer in charge of the work submitted a project for improving the river to give a depth of 7 feet at mean low water, and a minimum width of 50 feet. The estimated cost is $175,000.

The present channel is but 5 feet deep and has a width of but 40 feet in the narrowest places.

Congress appropriated $25,000 by act of September 19, 1890, to commence the improvement.

Under date of December 8, 1890, advertisements were issued inviting proposals for dredging to deepen the channel.

Bids were opened December 30, 1890, and the contract was awarded to the lowest bidder, Mr. Charles H. Souther, of Boston, Mass., at 39½ cents and $1.35 per cubic yard for soft and hard material, respectively, measured in scows.

The contractor is expected to commence work in July and carry it on continuously as far as may be done with available funds.

No tonnage statistics for the last year have been obtained, but the freights probably exceed those of the previous year, which were given as 40,000 tons.

The completion of the improvement will be a great benefit in saving of freight and will doubtless bring an increase of tonnage.

Money statement.

Amount appropriated by act approved September 19, 1890	$25,000.00
June 30, 1891, amount expended during fiscal year	215.29
July 1, 1891, balance unexpended	24,784.71
July 1, 1891, amount covered by uncompleted contracts	22,500.00
July 1, 1891, balance available	2,284.71
Amount (estimated) required for completion of existing project	150,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Cocheco River, New Hampshire, opened December 30, 1890.

No.	Name and address of bidder.	Price per cubic yard, measured in scows.	
		Soft material.	Hard material.
		Cents.	
1	Charles H. Souther, Boston, Mass	39½	$1.35
2	George Thomas Symonds, Kittery Point, Me	34 9/10	1.64 9/10
	George Walter Todd, Leominster, Mass		
3	Boynton Bros., Boston, Mass	50	2.00
4	Andrew K. Stone, Roxbury, Mass	49	1.90
5	Augustus R. Wright, Portland, Me	40	1.70
6	A. B. Martin, Boston, Mass	45	1.85
7	Robert Hamilton, Chebeague, Me	47	1.85
	Solomon Sawyer, Yarmouth, Me		

The contract was awarded to Charles H. Souther, Boston, Mass., his bid being the lowest in the aggregate.

	Tons.
Tonnage in freights	40,000

A 24.

HARBOR OF REFUGE AT LITTLE HARBOR, NEW HAMPSHIRE.

The project for this improvement, adopted in 1888, consists of two small breakwaters at the entrance to the harbor and dredging the channel and enlarged anchorage to a depth of 12 feet at low water.

The situation of this harbor and the reasons for its improvement as a harbor of refuge were explained in Report of Chief of Engineers for 1890, page 454, and in preceding reports.

At the beginning of the last fiscal year the funds previously appropriated, amounting to $30,000, had been expended in dredging the channel and anchorage.

By act of September 19, 1890, Congress appropriated $40,000 for the improvement.

Proposals for construction of a breakwater and beacon were invited by public advertisement dated December 1, 1890. Bids were opened December 30, 1890, and a contract for the work was awarded to Thomas A. Rowe, of Newton, Mass., who was the lowest bidder. The price for

stone delivered in the breakwater is 69 cents per ton and the price of the beacon is $450, the stone for the beacon being furnished by the United States.

Delivery of stone was commenced April 22, 1891. The beacon has been completed and 4,543 tons of stone have been placed in the breakwater.

It is expected that the work will be carried on continuously until completed.

There are no definite commercial statistics for this harbor, as it is essentially a refuge for all vessels which enter the Piscataqua River, as well as for some coasters.

NOTE.—For local commercial statistics, see Portsmouth Harbor, Cocheco and Bellamy Rivers.

Money Statement.

Amount appropriated by act approved September 19, 1890		$40,000.00
June 30, 1891, amount expended during fiscal year		3,442.44
July 1, 1891, balance unexpended		36,557.56
July 1, 1891, outstanding liabilities	$1,196.66	
July 1, 1891, amount covered by uncompleted contracts	31,325.81	
		32,522.47
July 1, 1891, balance available		4,035.09
Amount (estimated) required for completion of existing project		165,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Proposals for construction of breakwater and beacon at Little Harbor, N. H., opened December 30, 1890.

No.	Name and address of bidder.	Price per ton of 2,000 pounds. For stone furnished and delivered in the breakwater.	Price per ton of 2,000 pounds. For stone taken from near Fort McClary delivered in breakwater.	Price for construction of beacon complete.
1	Edwin H. French, Fulton, N. Y	$0.99	$0.99	$1,200.00
2	George Willett Andrews, Biddeford, Me	.92½	.87	647.00
3	Thomas A. Rowe, Boston, Mass	.69	.69	450.00
4	Pigeon Hill Granite Company, Rockport, Mass	1.47	1.10	1,625.00
5	Joseph F. Curit and Rufus A. Soule, Chebeague, Me	.97	.97	595.00

The contract was awarded to Thomas A. Rowe, Boston, Mass.

A 25.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

On the 6th of July, 1890, the wreck of the lime-laden schooner *Annie J. Russell* was reported by the harbor commission to be sunken in the roads between Little Diamond Island and Peak Island, in Portland Harbor, Maine.

Proposals for its removal were opened October 24, 1890, after advertisement and due notice to the owners.

The contract was awarded to John F. Hamilton, of Portland, Me., the lowest bidder.

The work of removal was completed on the 6th of November, 1890. The wreck was removed entire and deposited on the flats north of Cow Island.

The entire expense, including examination, removal, inspection, etc.,. was $650.

On the 21st of February, 1891, application was made to the Secretary of War, by parties interested in the navigation of the river, for the removal of the wreck of the schooners *Golden Eagle* and *Cerulius* from the channel of Pleasant River, Maine.

Proposals were opened April 14, 1891.

The contract was awarded to John C. Tibbetts, of Columbia Falls, Maine.

The work of removal was commenced as soon as the condition of the river would permit, and completed June 6, 1891.

The wrecks were removed entire and deposited on flats in a small bayou adjacent to the river, entirely beyond the possibility of further return to the channel.

The entire expense, including examination, removal, inspection, etc., was $700.

Abstract of proposals for the removal of the wreck of schooner Annie J. Russell, Portland Harbor, Maine, opened October 24, 1890.

No.	Name and address of bidder.	Price for removal of wreck.
1	Edward Moore and Augustus R. Wright, Portland, Me	$735
2	Philip H. Doyen, Portland, Me	790
3	John F. Hamilton, Portland, Me	575
4	L. E. Lunt & Co., Portland, Me	1,800

The contract was awarded to John F. Hamilton, Portland, Me.

Abstract of proposals for removal of the wrecks of schooners Golden Eagle and Cerulius, in Pleasant River, Maine, opened April 18, 1891.

No.	Name and address of bidder.	Removal of Golden Eagle.	Removal of Cerulius.	Total bid.
1	John C. Tibbetts, Columbia Falls, Me	$400	$175	$575
2	Geo. W. Townsend, Boston, Mass	375	265	640
3	Geo. C. Turner, Columbia Falls, Me	337	280	617
4	Jno. F. Hamilton, Portland, Me Joseph F. Curit, Chebeague, Me	----------	----------	1,700

The contract was awarded to John C. Tibbetts, of Columbia Falls, Me.

A 26.

PRELIMINARY EXAMINATION OF HARBOR OF BLUE HILL, MAINE, WITH ESPECIAL REFERENCE TO THE REMOVAL OF THE LEDGES KNOWN AS MIDDLE GROUND, EASTERN AND WESTERN.

[Printed in House Ex. Doc. No. 19, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated November 17, 1890, from Lieut. Col. Jared A. Smith, Corps of Engineers, giving results of preliminary examination of "harbor of Blue Hill, Me., with especial reference to the removal of the ledges known as Middle Ground, eastern and western," made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Smith concludes that the harbor of Blue Hill is not worthy of improvement, and I concur in this opinion.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL JARED A. SMITH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., November 17, 1890.

GENERAL: In compliance with requirements in Department letter of September 30, 1890, I have the honor to submit the following report of a preliminary examination of the "Harbor of Blue Hill, Me., with especial reference to the removal of the ledges known as Middle Ground, eastern and western."

In the afternoon of October 29, and morning of October 30, I had an opportunity of seeing the harbor at a very low stage of water. It was not convenient to visit the various obstructions in a boat, but they were fully pointed out to me, and explained by Capt. E. G. Conary, the principal pilot of Blue Hill Harbor, and they were also indicated and studied upon the chart.

To accompany and explain this report I inclose a small section of Coast Survey Chart, No. 307.* The entire chart covers Blue Hill Bay and the western part of Mount Desert Island, Me. The harbor proper is a small shallow bay, opening into the northwestern part of Blue Hill Bay, though the lettering upon the chart inaccurately indicates that the harbor is below, in the open water of Blue Hill Bay.

The obstructions known as the "Middle Grounds" are ledges of rock just outside the "Narrows" or entrance to the harbor. The Middle Grounds are known as the "eastern" and "western" and they divide the water into three channels designated as the eastern, middle, and western channels, though the latter is shallow and of little or no value.

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* Not printed.

The eastern Middle Ground is a ridge of ledge which is about 1,000 feet long and 300 feet wide between the contours of 18 feet depth and about 700 feet long by 150 feet wide between contours of 12 feet. The axis of the ridge lies nearly east and west. The top of the ledge projects above low water in two points about 500 feet apart, the western point being farther north than the eastern. Between this ledge and the shore on its north and east is the eastern channel, which is more than 300 feet wide where the depth of water is from 21 to 26 feet at mean low tide. The middle channel, which is between eastern and western Middle Grounds, has a width of 200 feet or more where the depth at low water exceeds 18 feet.

The western Middle Ground is somewhat smaller than the eastern. Upon the chart it at first appears to be a portion of the flats projecting from the point on the west side and immediately south of the "Narrows;" there is, however, a shallow channel between the western Middle Ground and the shore. This Middle Ground is also a ridge of solid ledge, having its axis approximately north and south and its top 3 feet below mean low water.

Were the western Middle Ground removed to a sufficient depth, the channel from the bay through the "Narrows" would be straight. In the "Narrows" the depth at low water exceeds 18 feet over a width of 150 feet or more at low water. The mean rise of tides is 10.1 feet above the plane of mean low-water, so that at high stages of the tide channels of good depth are sufficiently direct for all ordinary purposes.

The tidal basin inside the "Narrows" is small, and much of it is of flats out at low water, so that the tidal currents in the channels are not strong. In fair winds large vessels may be taken in and out, by a pilot, without difficulty; but in adverse or baffling winds it is necessary to wait for extreme high water.

Were the business of the place sufficient to furnish employment for a steam tug, vessels of good size could easily be taken in and out in all ordinary weather and tides.

The quantity of ledge in the western Middle Ground above a plane of 10 feet below mean low water, estimated as nearly as practicable from the Coast Survey Chart, is 13,582 cubic yards.

At the lowest rates that such work has been done by contract in this vicinity, the expense of removing the western Middle Ground to the depth mentioned would not be less than $150,000.

The quantity of ledge in the eastern Middle Ground has not been estimated, but it is at least twice as much as in the western, at which rate the cost of removing both Middle Grounds to a depth of 10 feet would exceed $450,000, and at the average rate at which appropriations would probably be made, if made at all, the time consumed in the work would exceed ninety years.

Were the western Middle Ground removed, however, the eastern Middle Ground would be no serious obstruction, so that the larger estimate need not be considered.

Inside the "Narrows" the harbor has a small area of water exceeding 18 feet in depth at mean low water, but more than half the entire harbor area is of flats uncovered at extreme low tides.

The harbor channel is very crooked and is beset with reefs and ledges.

On the east side of the "Narrows" is a projecting reef, bare at low water, known as Skulpin Ledge.

About 1,500 feet from the "Narrows," on the south side of the channel in a bend, lie three ledges known as the "Triangles," the tops being bare at low water. On the opposite side and only a few hundred feet

distant from the Triangles, is an obstruction known as "Witham's Ledge." The last ledge is in what is known as the "Inner Narrows," near the end of a long neck and point of land where there is a wharf used for a steamboat landing and other purposes. In the upper half of the harbor several other reefs project above low water.

As the Triangles and Witham Ledge are covered at most stages of the tide it would seem advisable to have them marked by spindles. Suitable marks of this kind may be placed without great expense. It is therefore recommended that this part of the subject be referred to the Light-House Board.

It will be readily seen that the improvements necessary to make this a good harbor would involve a vast expense, which could only be justified by the necessities of an extensive commerce.

Of the present and probable navigation and commerce of the place only approximate estimates can now be given.

I visited the principal granite works of Blue Hill, and there, as well as in other places, endeavored to obtain information which would be reliable.

The Blue Hill Granite Company, which commenced shipping stone in April, 1890, has its works on the northeast side of the harbor, a short distance above the "Narrows." The agent of the company being absent, no exact statement of the shipments by water could be obtained. The foreman, however, informed me that they were thus far probably less than the shipments from the White Granite Company, which is located a few hundred feet further up the shore.

The agent of the White Granite Company gave a list of twenty vessels which had taken away cargoes of granite from April 4 to October 27, 1890. The time covers approximately seven months. As shipments in winter are very few, the amounts given will doubtless cover at least three-fourths of the shipments for the entire year 1890.

The total of shipments were 4,191 tons. The largest vessel carried 475 tons, the smallest 120 tons, and the average tonnage of vessels was 204.55 tons. Shipment for entire year, estimated, 5,488 tons.

A third granite company is that of Howard & Greene. This is located somewhat distant from the landing, and the stone is hauled to the steamboat wharf for shipment. I did not visit this work, but ascertained in a general way that the output is small, probably not exceeding three cargoes, or, say, 600 tons per year. Estimating the Blue Hill and the White Granite Companies to be of equal capacity, the total estimated shipment of granite in 1890 would be 11,576 tons.

In addition to the above the other shipments may be estimated as follows: Chalk, 300 tons in four vessels; wood for lime-burning, 2,000 cords in fifty vessels; about 300 tons of coal, and 650,000 feet, board measure, of lumber represent the greater part of imports, save such articles as arrive on a small steamer, the *Henry Morrison*, which stops at the wharf three times each week.

Blue Hill is a small village and township, having a population of 2,213 in 1880, and probably about the same number at present. It is in no broad sense a commercial port, and there is no present indication that its business will increase to any radical extent in the near future.

The only business in which larger vessels might be advantageously employed is the shipping of granite. The present entrance to the lower part of the harbor is amply wide and deep for any probable requirement, but as it is not straight and the business is not sufficient to employ a steam tug, some delays must obtain in waiting for fair winds and tides.

Doubtless the removal of the Western Middle Ground, and perhaps some other obstructions, as well as the dredging of a channel in the upper part of the harbor, which is much desired, would result in great convenience and some benefit to the place. I can not, however, regard the probable benefits as sufficiently large or general in their character to justify the very large expense which they would be certain to entail.

I am therefore compelled to conclude that the harbor of Blue Hill is not worthy of improvement by removal of the ledges known as "Middle Ground, Eastern, and Western," nor at present to any extent, save by erecting one or more spindles as before indicated.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A 27.

PRELIMINARY EXAMINATION OF PEPPERELL COVE, MAINE, FORMING THE EASTERN BOUNDARY OF PORTSMOUTH LOWER HARBOR.

[Printed in House Ex. Doc. No. 62, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington D. C., December 5, 1890.

SIR: I have the honor to submit the accompanying copy of report, dated November 21, 1890, by Lieut. Col. Jared A. Smith, Corps of Engineers, giving results of preliminary examination of Pepperell Cove, Maine, forming the eastern boundary of Portsmouth Lower Harbor, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Smith states that the benefits to be derived from the improvements which are desired at Pepperell Cove appear to be local in their scope, and their amount would make a very small dividend upon the great expense. He is, therefore, of the opinion that the locality is not worthy of improvement.

In this opinion I concur.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL JARED A. SMITH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Portland, Me., November 21, 1890.

GENERAL: In compliance with instructions in Department letter dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of Pepperell Cove, Maine, forming the eastern boundary of Portsmouth Lower Harbor.

I have for some years been well acquainted with the location and general conditions of Pepperell Cove, as well as of the class of vessels navigating the Piscataqua River, of which the part below the bridge at Portsmouth is usually known as Portsmouth Harbor.

In order, however, to ascertain as nearly as possible any special points which might be presented to show the necessity of an improvement of Pepperell Cove, as well as what was considered necessary by the persons interested, I visited Portsmouth, N. H., and Kittery Point, Me., on the 1st of November, and made such inquiries as the opportunity afforded. So far as I could ascertain by inquiry, the movement to obtain an improvement of Pepperell Cove did not originate with masters or owners of vessels, nor with any other parties having a direct interest in commerce or navigation, but with the proprietor and one or more guests of a summer hotel upon Kittery Point adjacent to the cove. These parties formulated a petition which was circulated for signatures.

An inquiry of the President of the Board of Trade in Portsmouth elicited a reply to the effect that he knew nothing regarding the matter.

Inquiries at Kittery Point developed no unanimity of opinion regarding what should be done save that "it would be a good thing if the cove could be dredged."

To accompany and explain this report I inclose a section of Coast Survey chart,* No. 329, of Portsmouth Harbor, New Hampshire.

Pepperell Cove is about 2 miles from the open water of the Atlantic Ocean. Chauncey Creek, a small tidal branch, opens into the cove, which is merely a small shallow bay on the northeast side of a bend where the river changes its easterly course to one nearly south. The cove is thus exposed to seas which are driven into Portsmouth Harbor from the south and southeast.

One or more small wharves in very shallow water afford facilities for all the present or prospective demands of business at Kittery Point, though probably if the water were deeper a small steamer might touch at the place during the season of summer visitors at the hotels. It should, however, be remarked that the only opinions advanced in favor of the improvement were to the effect that a better and more secure anchorage was needed for small vessels which put into Portsmouth Harbor for refuge.

It is apparent that a depth of 12 feet at mean low water is as small as would serve any good purpose for a refuge. To dredge the cove outside of present low-water line to a depth of 12 feet would require the removal of about 355,000 cubic yards. The material appears to be generally of a compact sandy nature, though it is not improbable that solid rock might be found in places. Solid rock, which is characteristic of the surroundings, appears nearly in the middle of the mouth of the cove, in a ridge known as "Logy Ledge," having about 8 feet depth at low water over its top. One former vessel master insisted that "Logy Ledge" was a great obstruction and should be removed, and another considered it as of little consequence.

Several parties thought that a breakwater should be constructed from Gooseberry Island to the buoy off Fishing Islands. Such a breakwater, if built of rough stone dumped in place, would require about 15,000 tons, and it would probably cost somewhat more than $1 per ton. The object of the breakwater would be to prevent refilling by mud and sand from adjacent flats, and to exclude the seas which set into the harbor in southerly storms.

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*Not printed.

So far as the filling is concerned, it is my judgment that the breakwater of loose stone would produce very slight results, and in regard to the protection from seas it would be practically worthless.

When winds blow from any direction except southerly, all of the lower part of Portsmouth Harbor is well sheltered from seas, and the area is ample, without any deepening of Pepperell Cove; but when winds are southerly, the straight reach of 2 miles from the open sea is exposed, and the seas and undertow would then enter the cove, whether the suggested breakwater were built or not.

The protected anchorage in southerly storms is above the bend of the river where there is ample room, though the tidal currents are exceedingly strong.

The currents in Portsmouth Harbor are so very strong that with an ebb tide it is exceedingly difficult for vessels to enter the harbor under sail, and in adverse winds the difficulty is well-nigh insurmountable.

It is for this latter reason that Little Harbor is now being improved to make a harbor of refuge at the entrance to Portsmouth Harbor. Both Pepperell Cove and Little Harbor are shown upon the small section of chart herewith.

I have not been able to discover that an anchorage for refuge in Pepperell Cove is a public necessity. All the vessels which need to anchor there in any weather are very small, and might be better protected elsewhere. With a harbor of refuge for small vessels at the mouth of the river there can be no pressing need for another 2 miles further up.

The improvement, even if limited to the dredging of the small area of less than one-fifth of a square mile to a depth of 12 feet, could hardly cost less than $100,000 when completed, under four annual appropriations; but with biennial appropriations not exceeding $10,000 each it would be more likely to cost $150,000 and its accomplishment would be almost indefinitely deferred.

The benefits to be derived from the improvements which are desired appear to me to be local in their scope and their amount would make a very small dividend upon the great expense. Rates of freight and insurance on the coast could hardly be affected.

It is therefore my opinion that Pepperell Cove, Maine, forming the eastern boundary of Portsmouth Lower Harbor, is not worthy of improvement.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A 28.

PRELIMINARY EXAMINATION OF LUBEC CHANNEL, MAINE.

[Printed in House Ex. Doc. No. 158, Fifty-first Congress, second session.]

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 30, 1890.

GENERAL: In compliance with requirements of Department letter of September 20, 1890, I have the honor to submit a report of a preliminary examination of Lubec Channel, Maine.

Lubec Channel lies between the township of Lubec, on the extreme eastern boundary of the State of Maine, and Campobello Island, of the province of New Brunswick. At its narrowest place, which is between the village of Lubec and a point of the island, the distance is but 805 feet from high water on the end of Gun Rock to high-water mark on the Campobello shore; between the natural contours of mean high water on the respective shores the width is 960 feet, and between contours of mean low water the distance is but 390 feet.

Before the channel below the narrows was improved by the United States the mean low-water depth over the shallowest places did not exceed 5.2 feet.

A survey of the channel was made under direction of General Thom, by Mr. A. C. Both, United States assistant engineer, in October and November, 1878.

Tide observations during 56 consecutive days and nights gave the following results:

	Feet.
Level of mean high water above mean low water	17.02
Highest water above mean low-water level	20.7
Lowest water below mean low-water level	4.1
Extreme range of tides	24.8
Lowest high water above low-water level	15
Highest low water above low-water level	2.25
Least range of tides	12.75

It will be seen that at extreme low water the channel had a clear depth of but 1.1 feet, while at the lowest high-water stage the depth exceeded 20 feet.

On the 14th of October, 1890, I visited Lubec to inquire especially into the necessity for further improvement of the channel.

After passing Lubec, going southward, the channel leads into a small bay known as Quoddy Roads, which forms a good anchorage in northerly and northwesterly storms. When a storm changes from westerly to easterly directions vessels which are at anchor in the roads are seriously endangered and must accept the alternative of trying to ride out the storm or to escape through the narrows into the protected waters above.

Congress has recognized the importance of this channel, not only as a needed thoroughfare, but as an aid toward making Quoddy Roads a safe harbor of refuge.

Commencing with March 3, 1879, seven appropriations have been made for improving the channel, the last being by act of August 11, 1888.

The total of appropriations is $169,000. As a result a clear channel of 12 feet depth at mean low water has been made from Johnson Bay to Quoddy Roads. In the narrows the width is 220 feet.

The project adopted for a dredged channel over the bar or flats below the narrows contemplated a width of 275 feet in direct parts and 300 feet width in the bends.

Previous to appropriation of August 11, 1888, the amount estimated to complete the project was $22,500. The appropriation was for $20,000 only, leaving the small balance of $2,500 of the estimate. As the remainder, if appropriated and expended separately, would accomplish nothing appreciable at so distant a point, it was hoped that the work might be practically completed with the amount appropriated, and no further appropriation was asked.

Certain causes, however, subsequently ascertained, made the amount

to be removed more than was anticipated, so that when the funds were expended three short cuts with the dredge were still required, and the channel at the narrowest place is but 220 feet wide.

Had the full amount of estimate been appropriated the project could have been completed as planned.

I forward, in a separate package, a tracing* from a map of the channel. The part dredged to a depth of 12 feet at mean low water is shaded with black lines.

It will be observed that the dredged channel has two bends like a flattened S, and that the light-house recently completed is on the west side, near Quoddy Roads. The tidal currents do not follow the channel exactly, and as they are rapid, sail vessels often anchor in the channel to avoid grounding upon the bank.

Sail vessels having the right of way, meeting in the channel is very embarrassing to steamers moving with the current, which must go ahead or lose steerage way and if stopped are likely to be driven upon the bank. An experience of the kind mentioned has been sufficient to keep large steamers from using the channel, save at high stages or on a rising tide.

To what exact extent this channel has been or will be used as a thoroughfare can not now be definitely stated.

Before improvements were made vessels rarely went through, save at or near high water. Many sailing vessels now go through at all stages, except at extreme low water, at which time the channel depth is but 8 feet.

In going to the harbor of Eastport, or to Passamaquoddy Bay and the St. Croix River from the east, the distance saved by going through the narrows is about 10 miles. The inner route is sheltered from the open sea, and is the only one not in waters belonging to the province of New Brunswick.

The records of vessels passing in sight of the light station at Quoddy Head and life-saving station near the same point indicate 20,000 annually. With very many of these Lubec Channel is not only an element of convenience, but of safety.

The work is not at all local in its character, and local statistics, therefore, give but little indication of probable benefits.

The question of expense is of prime importance in considering the worthiness of the improvement. I have, therefore, indicated upon the tracing the lines to which the present dredged channel should be widened in order to afford a fair amount of room for safety and convenience.

The channel thus outlined is 500 feet wide at its narrowest place near the light-house, and is widened somewhat toward the anchorage. The upper part of channel proposed has a width of 650 feet, in order to make room in the bend and to give a better direction.

The expense of dredging to a depth of 12 feet at mean low water, or 8 feet at extreme low water throughout the channel thus outlined, may be estimated as follows, viz:

600,000 cubic yards measured in scows, at 35 cents	210,000
Contingent expenses of engineering, 10 per cent	21,000
Total	231,000

It is my opinion that the channel is worthy of improvement.

*Not reprinted.

The maps now in this office being considered sufficient for the purpose of plans and estimates, no estimate of the cost of a survey is here submitted.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A 29.

PRELIMINARY EXAMINATION OF SULLIVAN FALLS, HANCOCK COUNTY, MAINE, WITH A VIEW TO ITS IMPROVEMENT FOR NAVIGATION.

[Printed in House Ex. Doc. No. 84, Fifty-first Congress, second session.[

UNITED STATES ENGINEER OFFICE,
Portland, Me., December 4, 1890.

GENERAL: In compliance with instructions in Department letter dated September 20, 1890, I have the honor to submit the following report of an examination of Sullivan Falls, Hancock County, Me., with a view to its improvement for navigation.

On the 9th and 10th of October I visited the villages of Sullivan and West Sullivan, and examined the situation of the falls.

The general features of the location are shown upon Coast Survey chart of Frenchman Bay and eastern part of Mount Desert Island, No. 306. The connection with other waters is more fully shown upon Coast Chart No. 103, "Mount Desert Island, Frenchman and Blue Hill Bays, and approaches." A section of the last-named chart* is forwarded in a separate package, with a large scale map† of the obstructions at the falls, to accompany this report.

Sullivan River, as it is sometimes called, is a tidal branch, opening into the northern part of Frenchman Bay. The river extends about 6 miles above the bay, and forms the outlet of a large interior bay of about 4 miles in length, and in places more than a mile wide. This large bay is subdivided into parts known as Egypt Bay, Taunton Bay, and Hog Bay. The area of the tidal basin above the falls may be approximately given as 5 square miles.

A short distance above Sullivan Village a long narrow point of land called "Falls Point" rests upon a ridge of solid rock, and projects from the shore in such a manner as to appear like part of an immense natural dam closing about three-fourths of the width between banks at that place. The same general formation of ledge extends beyond the point and under the narrow channel, and higher parts of the irregular surface form dangerous obstructions to navigation.

The sectional area of the channel between banks at the falls is very small in comparison to the sections either above or below. The mean range of tides at the head of Frenchman Bay is 10 feet, but the small capacity of the channel at the falls does not permit a range much exceeding 6 feet in the small bays above.

As a result of the conditions described the stages of high and low water in the open sea occur at intervals of an hour or more before the

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* Not printed. † Not reprinted.

corresponding stages above the narrow place, so that the extreme differences of level included in a short distance between the water above and that below give a surface declivity and current velocity which obtains the name of Sullivan Falls.

The ebb and flood tides alternately produce a fall in opposite directions, though the somewhat greater outflow, in connection with the configuration of the bottom and shores, produces the greater rapid and fall on the last of the ebb tide.

High-water slack, directly over the obstructions at the falls, occurs when the tide of Frenchman Bay has fallen 1.81 feet, and low-water slack occurs after the tide has risen 1.82 feet. Mean high-water level is therefore 6.37 feet above the plane of mean low water.

Congress, by act of March 3, 1871, appropriated $10,000, and by the act of June 10, 1872, appropriated $25,000 for improving Sullivan River and Falls.

These appropriations were expended in removing three piers of a former bridge about 1 mile above the falls, and the top of Hatcher Rock, and other ledges shown on tracing accompanying this report, to a depth of 7 feet at mean low water. Wrought-iron spindles with day marks were also placed upon Half Tide Rock and Low Water Rock near the mouth of the river.

It should be remarked that while the improvement apparently affords a mean high-water depth of 13.37 feet over the rocks, the situation is peculiar, and tide observations taken at one point on the shore near the falls are not sufficient to give definite figures of the draft which may be safely carried by a loaded vessel.

The improvements have aided in largely developing the principal business, which depends upon navigation at this place.

The annual shipment of granite previous to 1871 was given as 80,000 cubic feet in 50 cargoes. This would be equal to about 6,600 tons in 50 cargoes of 132 tons each. There were also about 75 cargoes of wood and lumber.

In 1888, 321 loaded vessels were taken out over the falls. In 1889 the number was 379, and in 1890 there were 332 previous to my visit November 15. Estimating the number after that day to be the same as in the corresponding period of the previous year the total number in 1890 would be 363.

The net tonnage by United States measurement was, in 1888, 39,627 tons; in 1889, 43,651 tons; in 1890, 42,616 tons, actual and estimated.

The freights, however, are frequently nearly double the net tonnage of vessels, and the carrying capacity, which represents the freight more nearly than the net tonnage of the vessels, is given as follows, viz: in 1888, 70,894 tons; 1889, 78,231 tons; 1890, 76,966 tons, actual and estimated.

The greater portion of the freight is of granite, principally in the form of paving stones. These are shipped mainly from West Sullivan. Some lumber and wood are shipped from Franklin and other points on the upper bays.

It will be observed that the commercial interests are now at least three times as great as they were 20 years ago.

With the constantly increasing demand for paving stones and other forms of granite, a similar increase in the next 20 years may be considered probable.

The rates of freight and insurance are probably increased 25 cents or more per ton by the presence of the obstructions at Sullivan Falls.

If Hatcher Rock and two other points of ledge near the Sullivan

shore or Falls Point were removed 3 feet deeper than their present level, or to 10 feet depth at mean low water, the channel would not only be so improved as to give all that will probably be required, but the currents would also be sensibly modified, so that the time in which the passage may be made would be much decreased.

Such a removal would produce a clear channel of 150 feet width, in which the depth would not be less than 10 feet at mean low water, or 16.37 feet at mean high water by the gauge before mentioned.

This would require the removal of about 1,200 cubic yards of solid ledge, and probably a few loose stones.

In such a situation the removal of solid ledge is expensive, and the cost of the whole work can not be safely estimated at less than $35,000, when done in a single contract. The expense if done piecemeal would be largely increased.

In view of the present and prospective demands of the increasing business on Sullivan River and the probable cost of the permanent improvements required, it is my opinion that Sullivan Falls, Maine, is worthy of improvement.

The maps now in this office are considered sufficient, so that no estimate for a survey is here made. Should a project for improvement of Sullivan Falls be approved and an appropriation be made therefor, an examination of the channel to locate any small obstruction not now known would be sufficient.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

A 30.

ESTABLISHMENT OF HARBOR LINES AT LUBEC, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., March 2, 1891.

GENERAL: Referring to my letter dated February 4, 1891, I have the honor to report that in compliance with instructions in Department letter, dated February 11, 1891, I visited Lubec, Me., on the 25th of February, and made such inquiries and observations as seemed necessary for the purpose of establishing a harbor line under the provisions of section 12 of the river and harbor act of September 19, 1890.

The channel at Lubec is narrow and the rapid tidal currents give it many of the features of a river. It is not advisable to permit any wharves to extend so far as to interfere with the free use of the full width of the channel at high water and it appears desirable to permit, as far as practicable, the adjacent owners to build wharves as far as the line of mean low water.

An examination of all the points bearing upon the subject leads me to recommend the establishment of harbor lines as indicated upon a tracing forwarded in a separate roll to accompany this report.* There are two lines meeting near the middle of the channel front and so

* Omitted.

located as to approximate as nearly as possible the line of mean low water.

There appears to be no present occasion for the establishment of harbor lines other than upon the front indicated.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
March 5, 1891.

Respectfully submitted to the Secretary of War.

Protests having been made in regard to a proposed extension of a wharf belonging to Mr. H. S. Kelly, at Lubec, Me., Lieut. Col. Jared A. Smith, Corps of Engineers, the officer in charge of the improvement of Lubec Channel, was instructed from this office to make the necessary examination and submit a map of the locality having upon it harbor lines recommended for adoption.

The within report and accompanying map prepared under these instructions are respectfully submitted with recommendation that the harbor lines as shown on the map be approved by the Secretary of War under the provisions of section 12 of the river and harbor act approved September 19, 1890, and that the Secretary place his approval both upon the tracing and this communication.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *March 6, 1891.*

Respectfully returned to the Chief of Engineers with approval of the location of the harbor lines indorsed on this paper and the accompanying tracing as recommended.

L. A. GRANT,
Assistant Secretary of War.

A 31.

ESTABLISHMENT OF HARBOR LINES IN KENNEBEC RIVER AT BATH, MAINE.

UNITED STATES ENGINEER OFFICE,
Portland, Me., July 9, 1891.

GENERAL: Referring to Department letter of March 26, 1891, I have the honor to submit the following report of a survey of wharves and river front of the Kennebec River at Bath, Me., with my views regarding the establishment of harbor lines, under the provisions of section 12 of the river and harbor Act of September 19, 1890.

In May, 1891, Mr. F. S. Burrowes, United States assistant engineer,

made a survey of the harbor front mentioned, with hydrographic work sufficiently extensive and in detail.

The survey has been platted on a scale of 1:4,000. A tracing of the map* is forwarded in a separate package by mail.

The lines which are recommended for adoption as harbor lines are shown in red upon the map.

At the extreme upper end of the harbor front the river is about 1,350 feet wide between the wharves at Bath and high-water mark on the opposite shore.

At this point the currents are quite rapid, and there are many reasons why it is desirable to preserve the present width as nearly as practicable. The lines around this point are therefore made to conform as nearly as practicable to the contour of 12 feet depth, which is near the end of the wharves.

Below this point the river becomes much wider, and it seems desirable to permit the extension of wharves to a greater depth of water, so far as it may be done without interfering with any general interest of navigation. This affords a depth ranging from 12 feet to more than 30 feet along well-defined lines.

The managers of the Maine Central Railroad and the Bath Iron Works, the two largest interests represented at Bath, are making considerable improvements, and desire extensions of the wharf fronts some distance beyond their present limits.

The river at the first of these places is at least 700 feet wider than it is above, so that no inconvenience will arise from establishing the harbor line farther out, and this is necessary in order to obtain as great a depth of water as is found on the adjacent section of front above.

There are several ledges along the front below, for the removal of which estimates have been submitted. By putting the harbor line outside these ledges ample width will be allowed for the river, the greatest interests at Bath will be accommodated, and expense will be saved to the United States.

I therefore recommend the adoption of the lines as indicated upon the tracing.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
July 13, 1891.

Respectfully submitted to the Secretary of War.

Request having been made for the establishment of harbor lines in the Kennebec River at Bath, Me., and Lieut. Col. Jared A. Smith, Corps of Engineers, the officer in charge of the improvement of the Kennebec River, having recommended that harbor lines be established at Bath under the provisions of section 12 of the river and harbor act approved September 19, 1890, he was instructed from this office to make the necessary survey, and submit a map of the locality, having upon it harbor lines recommended for adoption.

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* Omitted.

The written report and accompanying map prepared under these instructions are respectfully submitted, with recommendation that the harbor lines as shown on the map be approved by the Secretary of War, under the provisions of section 12 of the river and harbor act approved September 19, 1890, and that the Secretary place his approval both upon the tracing and this communication.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT, *July 15, 1891.*

Approved, and respectfully returned to the Chief of Engineers.

L. A. GRANT,
Acting Secretary of War.

APPENDIX B.

IMPROVEMENT OF CERTAIN RIVERS AND HARBORS IN MASSACHUSETTS.

REPORT OF LIEUTENANT-COLONEL S. M. MANSFIELD, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Newburyport Harbor, Massachusetts.
2. Merrimac River, Massachusetts.
3. Powow River, Massachusetts.
4. Ipswich River, Massachusetts.
5. Harbor of refuge, Sandy Bay, Cape Ann, Massachusetts.
6. Gloucester Harbor, Massachusetts.
7. Manchester Harbor, Massachusetts.
8. Salem Harbor, Massachusetts.
9. Lynn Harbor, Massachusetts.
10. Winthrop Harbor, Massachusetts.
11. Boston Harbor, Massachusetts.
12. Weymouth River, Massachussetts.
13. Hingham Harbor, Massachusetts.
14. Scituate Harbor, Massachusetts.
15. Plymouth Harbor, Massachusetts.
16. Wellfleet Harbor, Massachusetts.
17. Provincetown Harbor, Massachusetts.
18. Chatham Harbor, Massachusetts.

EXAMINATIONS AND SURVEYS.

19. North River, Salem, Massachusetts, from Beverly Bridge to the North Street Bridge.
20. Shoals at the mouth of North River, Massachusetts, with a view of removing the same and other obstructions.
21. Mystic River, Massachusetts, and the Malden River, a tributary of the Mystic, from the bridge of the Boston and Maine Railroad, eastern division, to the head of navigation on said rivers.
22. Essex River, Massachusetts.
23. Town River, Massachusetts.
24. Weymouth Back River, Massachusetts.
25. Kingston Harbor, Massachusetts.

HARBOR LINES.

26. Establishment of harbor lines in Boston Harbor, Massachusetts.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., July 9, 1891.

GENERAL: I have the honor to transmit herewith annual reports for the works of river and harbor improvement in my charge for the fiscal year ending June 30, 1891.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

B 1.

IMPROVEMENT OF HARBOR AT NEWBURYPORT, MASSACHUSETTS.

Newburyport is situated on the south bank, 2½ miles, approximately, from the mouth of the Merrimac River. The river empties into the Atlantic Ocean midway between Cape Ann and Portsmouth, or about 30 miles a little east of north from Boston in a direct line.

The outlet of the river between Plum Island and Salisbury Point is 1,000 feet wide and 30 feet deep at mean low water. At a distance of nearly a mile outside lies a sandy bar, thrown up by wave action, through which, previous to the improvement, a channel, variable in position, direction, and depth, was maintained by the current of the river, increased by the tidal prism in a large interior basin, due to a range of tides equaling 7½ feet.

For 1,000 feet outward from the gorge toward the crest of the bar the current was able to maintain a channel of navigable width and 18 feet deep at mean low water, and for a further distance of 1,500 feet a channel 12 feet deep. From the 18-foot contour line on the inside to the same on the outside the distance was 4,000 feet, and between the 12-foot contours the distance was 3,000 feet.

The depth on the crest of the bar was generally less than 7 feet at mean low water.

The object of the improvement is to create through the outer bar a channel 1,000 feet wide and at least 17 feet deep at mean low water, so that vessels may cross the bar and find a harbor, at any stage of the tide, with as great draft as can reach Newburyport by the river at high tide.

The project submitted September 16, 1880, proposed two converging rubblestone jetties, their outer ends parallel for 1,000 feet, and about the same distance apart; and the protection of the beach in their vicinity. This was modified in 1882 so as to provide for the partial closing of Plum Island Basin with a timber dike about 800 feet long and 5½ feet above mean low water.

The direction of the south jetty and the character of the shore protection was modified in 1883. The north jetty, from Salisbury Beach, is to be 4,000 feet long, approximately, and the south jetty, from Plum Island, is to be 2,400 feet long, approximately.

Both are 15 feet wide on top, which is in a plane 12 feet above mean low water. The two jetties have slopes of one on two on the sea side, and of one on one on the harbor side.

A map showing the location of the jetties is published in the Annual Report of the Chief of Engineers for 1885.

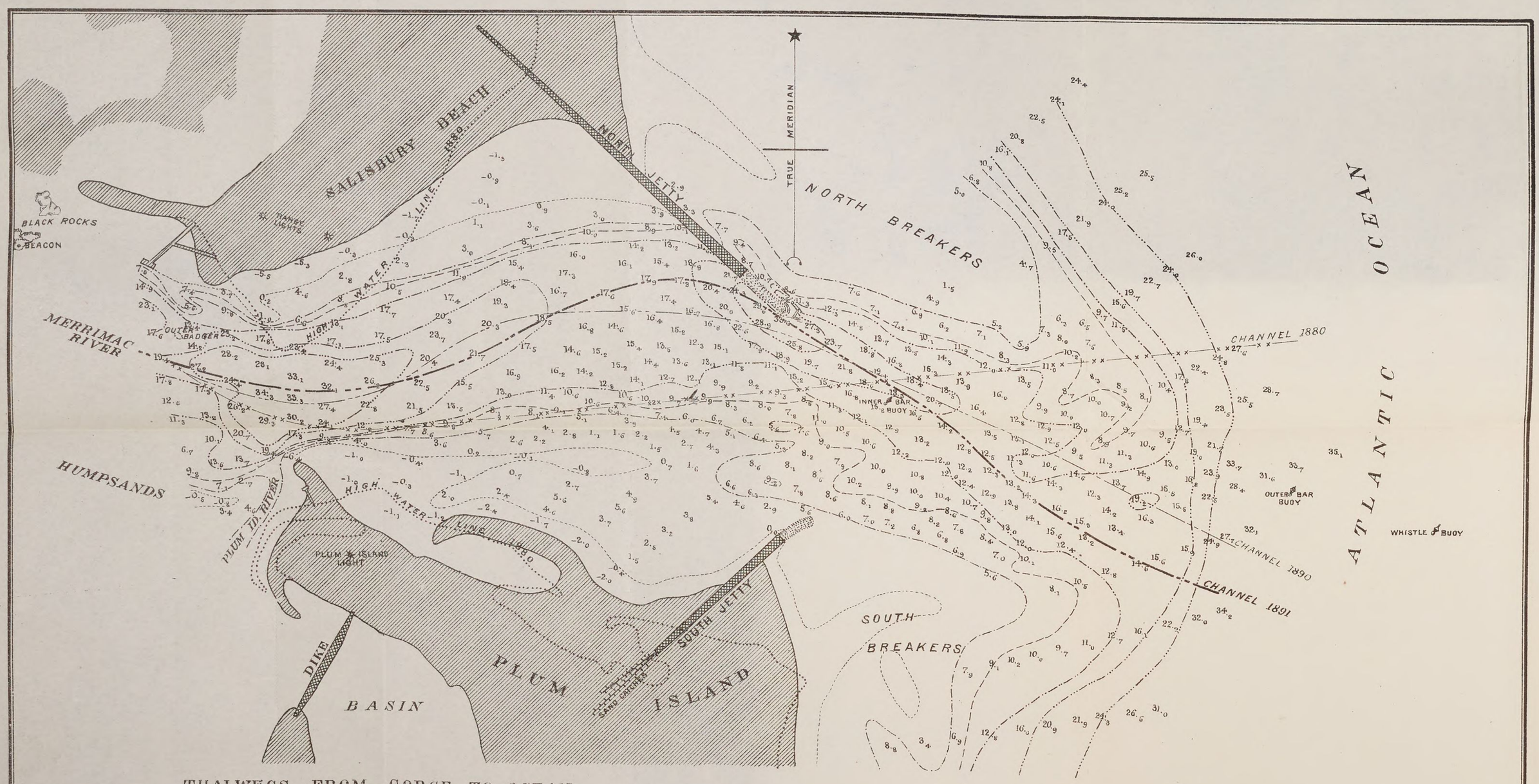
Their form and dimensions are shown in the report for 1881. The location and details of construction of the dike are given in the report for 1883. The estimated cost for the improvement was $375,000.

The total appropriations to date have been $257,500.

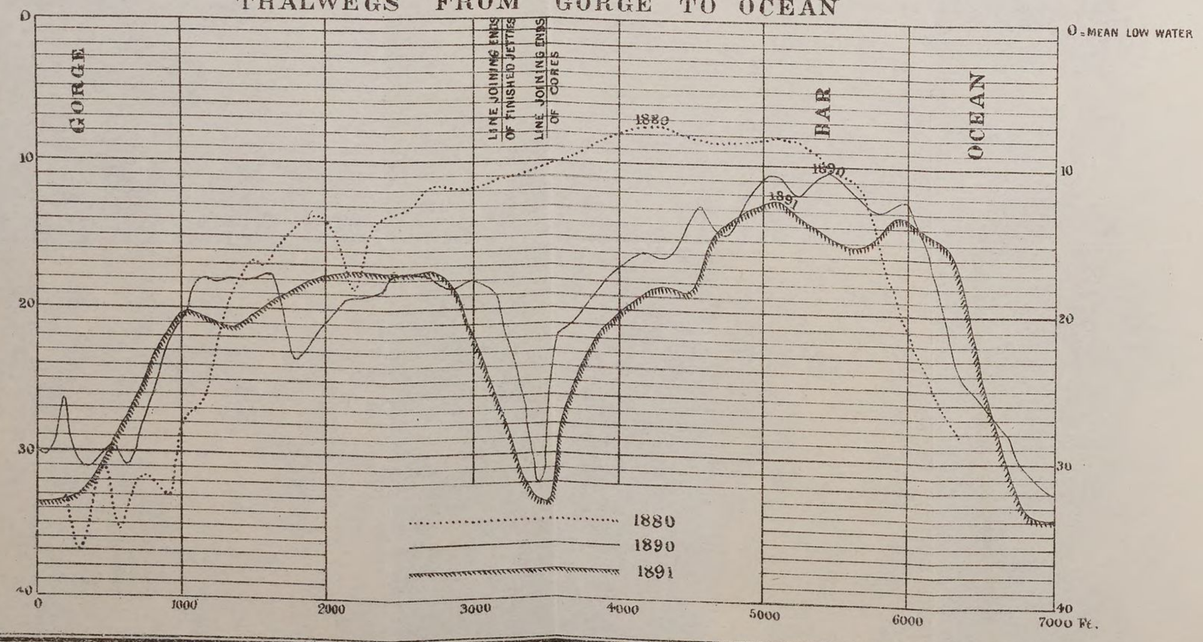
The amount expended to June 30, 1890, was $231,101.25.

On June 30, 1890, the condition of the improvement was as follows: The north jetty was completed for 2,200 feet in length and 475 feet in addition were partly completed; the south jetty had been completed 1,077 feet and partly completed for an additional distance of 223 feet, and its shore end had been strengthened by a durable sand catch; the dike had been completed so far as was prudent at the time for its safety. It was 817 feet long, 5½ feet high above mean low water, except that near its center a weir had been left 150 feet long and 2 feet above mean low water. The least depth in the channel across the bar was 10.3 feet at mean low water.





THALWEGS FROM GORGE TO OCEAN



NEWBURYPORT HARBOR, MASS.

PLAN SHOWING CONDITION OF IMPROVEMENT

TO ACCOMPANY ANNUAL REPORT OF

LT. COL. S.M. MANSFIELD, CORPS OF ENGRS. U.S.A.

1891

SCALE OF MAP

1000 500 0 1000 1500 2000 2500 3000 Ft.

U.S. Engineer Office
Boston, Mass. June 30. 1891.

LT. COL. OF ENGINEERS.

The river and harbor act of September 19, 1890, appropriated $25,000 for this improvement. On October 1, 1890, a project for the expenditure of this amount was submitted, and approved October 6, 1890. It proposed to continue the full section of the north jetty.

An advertisement under date of October 15, 1890, was issued, inviting bids for the proposed work. An abstract of the proposals received will be found in the annexed table. On December 3, 1890, a contract was entered into with Mr. Joseph H. White to deposit in the north jetty 1,000 tons, more or less, of rubblestone, which it is estimated will extend the full section of the north jetty 300 feet.

Operations under this contract were commenced early in May, 1891, and during the fiscal year 4,279 tons had been deposited in the north jetty, essentially completing it for an additional distance of 100 feet, or 2,300 feet in all.

During the latter part of May, 1891, a survey of the bar was made. It shows, first, that the channel crossing the bar has moved slightly to the southward and has deepened so that the least depth of water on the bar is 12.1 feet at mean low water in a straight channel at least 300 feet wide. The distance across the bars between 18-foot contours is 1,800 feet. On the outside of the bar no essential change is apparent in the position of the deep-water contours. Inside of the bar the 18-foot curve has advanced eastward 800 feet. Inside of the jetties, although extensive changes have taken place in the high-water line, the low-water line is essentially as in 1890, and the deep-water contours show no change of importance. In a word, the improvement shows a decided change for the better.

At the date of this report the condition of the south jetty and the dike is the same as on June 30, 1890.

From notes furnished by Mr. Hiram F. Mills, engineer of the Essex Company, at Lawrence, Mass., it is known that the spring freshet in the Merrimac River was of more than the average in duration and extent.

To complete the improvement an appropriation of $117,500 will be required, all of which could be expended to advantage during the fiscal year ending June 30, 1893, in the extension of both jetties to their full projected lengths.

The advantages to be derived from the completion of the project are the deepening and widening of the channel across the bar, thereby affording a harbor of refuge on the inside of Salisbury Beach, and giving easy access at high tide to the wharves at Newburyport for vessels drawing 17 feet, approximately.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the port of entry. The nearest light-house is on Plum Island, at the entrance of the harbor.

The accompanying commercial statistics for the fiscal year ending June 30, 1891, have been furnished by the collector of customs for Newburyport, Mass.

Money statement.

July 1, 1890, balance unexpended		$1,398.75
Amount appropriated by act approved September 19, 1890		25,000.00
		26,398.75
June 30, 1891, amount expended during fiscal year		3,611.50
July 1, 1891, balance unexpended		22,787.25
July 1, 1891, outstanding liabilities	$3,532.06	
July 1, 1891, amount covered by uncompleted contracts	8,409.87	
		11,941.93
July 1, 1891, balance available		10,845.32

Amount (estimated) required for completion of existing project.....$117,500.00
Amount that can be profitably expended in fiscal year ending June 30,1893 117,500.00
Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for rubble stone for the extension of north jetty, at entrance to Newburyport Harbor, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Names and addresses of bidders.	Price bid for stone per ton of 2,000 pounds.	Remarks.
1	Joseph H. White, Boston, Mass	$1.47	Lowest bid.
2	George Willett Andrews, Biddeford, Me	1.87½	
3	Thomas A. Rowe, Newton, Mass	1.53	
4	Rockport Granite Co., and Pigeon Hill Granite Co., Rockport, Mass	1.95	
5	Edwin Canney, Pigeon Cove, Mass	1.53	
6	Jeremiah Cushman, Newburyport, Mass	1.69	

Contract awarded to Joseph H. White, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $1,955.68.

Shipping.	1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*
Entrances—				
Foreign	25	2,425	8	892
Domestic	321	88,825	....	.....
Clearances—				
Foreign	41	6,411	8	913
Domestic	309	85,384	4	780

Imported.	1890.	1891.
	Tons.	*Tons.*
Coal	208,000	1,470
Lumber	1,000	.....
Miscellaneous	340	190

Average draft of vessels entering the harbor is 11½ feet; maximum draft, 5 feet.
The building of the jetties has already deepened the water several feet, and now vessels of 10 feet draft can easily come in at low water.

B 2.

IMPROVEMENT OF MERRIMAC RIVER, MASSACHUSETTS.

The mouth of Merrimac River is 15 miles northwest from Cape Ann, Mass. Tide-water extends up it a distance of 19 miles, or to the foot of the "Upper Falls," 1½ miles above Haverhill, Mass.

Seven incorporated cities and the largest mills in New England are directly interested in its improvement.

Before improvement the channel was narrow and crooked and much obstructed by ledges, bowlders, and shoals.

At mean low water vessels drawing not to exceed 7 feet could enter the river and proceed to South Amesbury, 9 miles from the mouth. The sea bar at the mouth of the river has been improved under specific appropriations for improvement of Newburyport Harbor, while many sunken rocks and wrecks of piers and vessels lying inside the bar have been removed by general appropriations for the improvement of the river.

The object of the Merrimac River improvement is to straighten, widen, and deepen the natural channel from the bar to the head of tide water at the upper falls of a group known as "Mitchell's Falls."

The rise or fall of the tide at the mouth is 7.7 feet; at Haverhill Bridge, 4 feet.

No plan of the river above Newburyport has been published in the Reports of the Chief of Engineers.

The project originally adopted in 1870 proposed to remove obstructions from the Upper and Lower Mitchell's Falls, and to remove the gangway rock and the "Boilers" in Newburyport Harbor.

The cost was estimated to be $69,025.

This project was modified in 1874 so as to include the removal of rocks in and near the draw of the bridge at Deer Island, 2 miles above Newburyport, and Rock's Bridge, and at Little Currier's Shoal, East Haverhill, so that the channel should have the following depths at ordinary high-water stages of the river:

From the mouth of Deer Island Bridge, 5 miles, 16½ feet; from Deer Island Bridge to Haverhill Bridge, 12½ miles, 12 feet; thence to the foot of Mitchell's Falls, Hazeltine Rapids, 1½ miles, 10 feet; through Mitchell's Falls to the head of the Upper Falls, 2½ miles, not less than 4½ feet, when the mill-water at Lawrence is running.

This revised project was estimated to cost $147,000.

The total appropriations to date have been $185,500.

The total expenditures to June 30, 1890, were $175,500.

The excess of expenditures over the estimate is due to the removal of rocks and other obstructions that were unknown and removal not contemplated when the estimate was made, and by the expense of necessary surveys and examinations not provided for in the estimate.

The condition of the improvement, June 30, 1890, was as follows:

The modified project of 1874 was completed with the exception of the removal of the "Boilers," upon which no work had been done.

During the year ending June 30, 1891, no active operations have been in progress.

The project, as modified in 1874, has been completed with the exception of the removal of the "Boilers," but from 1883–1886 additional improvements were recommended as follows:

For that part of the river below Mitchell's Falls—	
(1) To remove sunken rocks and shoals from Mitchell's Falls	$1,500
(2) To remove the "Boilers" to a depth of 5 feet at mean low water, 350 cubic yards, at $25	8,750
Contingencies	1,250
Total	11,500

To extend the improvement so that the same depth of water as is now obtained through Mitchell's Falls can be carried to Lawrence (a

distance of 5 miles from the head of the falls) was in 1882 estimated to cost for dredging through Gage's Shoal and Andover Bar, and removing bowlders and ledges, $11,000.

The improved channel is in good order.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Plum Island Lights and the Newburyport Upper Harbor Lights.

Commercial statistics are included in statement for Newburyport Harbor.

No increase in the tonnage of the river is apparent since the improvement was commenced, and no new lines of water transportation have been established.

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000.00
July 1, 1891, balance unexpended	10,000.00
Amount (estimated) required for completion of existing project	1,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

B 3.

IMPROVEMENT OF POWOW RIVER, MASSACHUSETTS.

Powow River is a tributary of the Merrimac River, which it enters from the north about 3½ miles above Newburyport. The tide enters the river a distance of about 9,600 feet, following the channel, or to a dam just above the town of Amesbury, Mass. The present channel is narrow, exceedingly crooked, and is not navigable at low water. The mean range of the tide at the mouth of the river is 6.7 feet.

The general project of the improvement of the river was proposed January 24, 1885. It was based on the survey provided for in the river and harbor act of July 5, 1884. This project proposed to make a channel 9,600 feet long, 60 feet wide on the bottom, and 12 feet deep at mean high water, at an estimated cost of $77,000.

Two appropriations have been made for this improvement, viz, by the river and harbor act of August 11, 1888, which appropriated $3,000 for dredging:

Provided, That this sum shall not be expended until the towns of Amesbury and Salisbury, or either of them, shall have caused such a draw to be placed in the present bridge over said river as may be approved by the Secretary of War.

And by the river and harbor act of September 19, 1890, $5,000, with a similar proviso.

On April 10, 1889, the Secretary of War approved the plan of the proposed bridge.

No action has as yet been taken by the authorities which will warrant the expenditure of the available funds.

To complete the improvement will require an appropriation of $69,000. Of this amount $30,000 could be expended to advantage during the fiscal year ending June 30, 1893, if the bridge at the mouth of the river shall have been rebuilt in accordance with the approved plans.

This work is located in the collection district of Newburyport, Mass., of which Newburyport is the nearest port of entry. The nearest light-houses are the Newburyport Upper Harbor Lights.

Commercial statistics are included in statement for Newburyport Harbor.

No increase in the tonnage of the river is apparent and no new lines of water transportation have been established.

Money statement.

June 1, 1890, balance unexpended	$3,000.00
Amount appropriated by act approved September 19, 1890	5,000.00
July 1, 1891, balance unexpended	8,000.00
Amount (estimated) required for completion of existing project	69,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 4.

IMPROVEMENT OF IPSWICH RIVER, MASSACHUSETTS.

Ipswich River empties into Plum Island Sound, 9 miles south of Newburyport, Mass., and at the same distance west of Cape Ann. The head of navigation is 3 miles above the mouth.

The entrance of Plum Island Sound is 2 miles east of the mouth of the river. Six feet depth at mean low water can be carried over the bar at the entrance to the sound, and between the bar and the mouth of the river there is a good anchorage, with from 3 to 5 fathoms of water.

Before improvement the channel of the river from its mouth to "Barras Turn," a distance of 2 miles, was at least 60 feet wide and 4 feet deep at mean low water. From "Barras Turn" to the town wharves, a distance of 1 mile, the channel was narrow and crooked, and had at some places but 1½ feet depth at mean low water. The mean rise or fall of the tide is 8.4 feet.

The original project for improvement was submitted December 6, 1875. It proposed a channel 60 feet wide and 4 feet deep, mean low water, from "Barras Turn" to the town wharves, at an estimated cost of $25,000.

On November 5, 1883, the original project was divided into three partial projects:

1. The removal of the ledges at Heards Point and opposite Nabbys Point to a depth of 2 feet at mean low water, to open a navigable channel of that depth, at a cost of $15,900.

2. To dredge the shoal at "Labor in Vain" and "The Shoals," so as to open a channel 4 feet deep at mean low water and 60 feet wide, at a cost of $2,200.

3. To straighten the channel by making a cut across "Barras Turn," and to build a jetty to close the old channel, at a cost of $6,900.

In the Annual Report of 1887 it was recommended that the general project be modified by limiting the present improvement to opening a channel 60 feet wide and 4 feet deep through "The Shoals" and "Labor in Vain," and extending it to the "Deep Hole," opposite the town wharves.

A chart showing this limited project was published in the report of the Chief of Engineers for 1887.

The amount which has been appropriated for this improvement to date is—

By the act of August 5, 1886	$2,500
By the act of August 11, 1888	2,500
Total	5,000

The amount expended to June 30, 1890, was $2,537.08, and a channel had been dredged 4 feet deep at mean low water, 60 feet wide at "Labor in Vain," and 40 feet wide at "The Shoals."

During the fiscal year no operations were in progress.

Proposals were twice invited during the year 1889, and it is evident that the work will cost more than the original estimate. The expenditure of the small amount available would result in no appreciable benefit to commerce; it therefore will be retained in the Treasury until additional funds are provided.

The condition of the improvement at date is the same as on June 30, 1890.

To complete the original project would require an appropriation of $20,000, but the present proposed partial project, it is believed, will fully meet all the reasonable demands of the present commerce of the river, and this it is estimated can be effected by an additional appropriation of $2,500.

Ipswich River is in the collection district of Newburyport, Mass. The nearest light-house is the Ipswich Light, on Castle Neck, about 1½ miles southeast from the mouth of the river.

Commercial statistics are included in the Newburyport Harbor.

No increase in the tonnage of the river is apparent and no new lines of water transportation have been established.

Money statement.

July 1, 1890, balance unexpended	$2,462.92
July 1, 1891, balance unexpended	2,462.92
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

B 5.

HARBOR OF REFUGE, SANDY BAY, CAPE ANN, MASSACHUSETTS.

Sandy Bay is situated at the northeastern extremity of the promontory of Cape Ann, which forms the northern limit of Massachusetts Bay. The shore lines of the bay form a little less than a right angle, and their directions are nearly north and south and east and west. The rocky island of Straitsmouth forms the eastern extremity of one shore line, and the steep headland of Andrews Point the northern end of the other.

Following the line of the proposed breakwater, the bay is 2¾ miles wide, and it has a depth of 2 miles approximately.

The bay on the land side is perfectly protected by steep high hills, but it fronts the northeast, and is open to the full force of the violent northerly and easterly gales of this coast.

The great seas of the ocean are broken, however, in a degree by the

sunken rocky ledges called Averys Ledge, the Dry and Little Salvages, the Flat Ground, and Abners Ledge, which are directly at the mouth of the bay. Inside these entrance ledges the bay is entirely unobstructed, and has an average depth of 50 feet at mean low water.

A plan of the bay, showing the proposed breakwater, was published in the Annual Report of the Chief of Engineers for 1886, page 582.

The project for improvement was submitted in 1884. It proposes a continuous breakwater 9,000 feet long, divided into two branches; one starts at Averys Ledge and runs in a direction a little west of north to Abners Ledge, a distance of 3,600 feet; the other extends 5,420 feet from Abners Ledge in a northwesterly direction, and terminates at the 83-foot contour off Andrews Point.

The axis of the proposed breakwater is approximately at the inner edge of the ledges at the entrance of the bay, and about 1 mile inside the Salvages and Flat Ground, which receive the first shock of easterly storm waves.

The southern entrance to the proposed harbor lies between Straitsmouth Island and Averys Ledge, and is to be 1,800 feet wide and at least 30 feet deep. The northern entrance, near Andrews Point, is 2,700 feet wide and 80 feet deep.

They are so located with reference to each other that vessels can enter and leave the harbor with any wind.

The harbor formed by the breakwater covers an anchorage of 1,377 acres, in which the depth exceeds 24 feet at mean low tide.

The breakwater will be formed to the level of 22 feet below low water, of a mound of broken stone, 40 feet wide at top, above which a masonry wall has been suggested, the crest of which shall be 15 feet wide and 8 feet above extreme high water. The detailed plan for the construction of the masonry wall has not been definitely adopted, and operations have been confined to the construction of the rubblestone mound or substructure of the breakwater. This is effected by dropping stone from vessels and self-dumping scows along the axis of the breakwater, extending to the eastward and westward, a distance of 20 feet, approximately. The axis is indicated by an iron spindle on Averys Ledge when in range with the south light-house on Thatchers Island. Cross ranges are established by iron pipes let into the rocks on Dry and Little Salvages, which mark points at intervals of 100 feet from the spindle (initial point) on Averys Ledge.

The estimated cost of the improvement is $5,000,000, to which must be added $2,500,000 for buoyage, lighting, and defense of the harbor.

These estimates are based upon consecutive annual appropriations of not less than 10 per cent. of the original estimates of cost.

Should operations be suspended at any time from want of funds, or annual appropriations be reduced to small sums for a series of years, the expense for the final construction will be proportionally increased.

The amount which has been appropriated to date is $450,000.

The total amount expended to June 30, 1890, was $287,765.56. At that date 352,934 tons of rubblestone had been deposited in the substructure of the breakwater, essentially completing it between cross ranges 140 and 3540.

During the fiscal year a survey was made of the site of the north branch of the breakwater. The survey showed that the axis of this branch (cross range 3540) could not be altered to advantage.

The act of September 19, 1890, appropriated $150,000 to continue this improvement. It was recommended that this sum be expended in extending the rubble mound, and this recommendation having been

approved, public advertisement was issued under date of October 15, 1890, calling for bids for the proposed work.

An abstract of the bids received will be found in the annexed table.

On December 4, 1890, a contract was entered into with the Rockport and Pigeon Hill Granite Companies for the delivery in place of 185,000 tons of rubblestone at 73½ cents per ton. This contract expires June 30, 1892.

Operations under this contract were commenced early in January, 1891, and on June 30, 1891, 54,239 tons of rubblestone had been delivered by the contractors, essentially completing the substructure between cross ranges 3540 and 3740.

To complete the project will cost $4,550,000, approximately.

During the fiscal year ending June 30, 1893, $250,000 could be expended to advantage in the extension of the substructure of the breakwater.

The prospective benefits to commerce and navigation by the construction of this harbor of refuge are increased safety to life and property, and a consequent reduction in freight and insurance.

Sandy Bay is situated in the collection district of Gloucester, Mass.

The nearest light-house is Straitsmouth Light, situated on Straitsmouth Island, at the southern entrance of the bay.

The accompanying commercial statistics for the fiscal year ending June 30, 1891, have been furnished by Mr. Charles S. Rogers, Rockport, Mass.

Money statement.

July 1, 1890, balance unexpended		$26,856.93
Amount appropriated by act approved September 19, 1890		150,000.00
		176,856.93
June 30, 1891, amount expended during fiscal year		49,178.30
July 1, 1891, balance unexpended		127,678.63
July 1, 1891, outstanding liabilities	$10,913.16	
July 1, 1891, amount covered by uncompleted contracts	96,109.34	
		107,022.50
July 1, 1891, balance available		20,656.13
Amount (estimated) required for completion of existing project		4,550,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		250,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for the delivery of rubblestone for harbor of refuge, Sandy Bay, Cape Ann, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No. of proposal.	Names and address of bidders	Price bid for stone per ton of 2,000 pounds.	Remarks.
1	Rockport Granite Company and Pigeon Hill Granite Company, Rockport, Mass.	$0.73½	

Contract awarded to the Rockport and Pigeon Hill Granite Companies with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

ROCKPORT, MASS., *July 28, 1891.*

DEAR SIR: Below we give you list of commercial statistics for Sandy Bay for the year ending June 30, 1891, as we have gathered from the best information attainable, viz:

Stone shipped	tons	160,000	Medicine oil	gals	4,700
Coal received	do	8,126	Cod oil	do	7,200
Wood received	cords	490	Lobsters	bbls	600
Lumber received	feet	200,000	Salt	hhds	1,000
Fish received	pounds	2,340,000			

Yours, truly,

CHAS. S. ROGERS,
Treasurer.
Per J. L. WOODFALL.

S. M. MANSFIELD,
Colonel, U. S. Engineers.

B 6.

IMPROVEMENT OF HARBOR AT GLOUCESTER, MASSACHUSETTS.

This is the most important harbor between Boston and Portland, and is the principal resort for all New England fishing vessels. It is situated at the southeastern extremity of Cape Ann, 20 miles northeast from Boston. It is easily entered when the dangerous storms of this coast occur, and provides a secure, ample shelter for all classes of vessels except from south winds, and from these a moderate extent of protected anchorage is afforded in the inner harbor.

It contains in the outer roadstead, the inner harbor, and in the channel connecting them sufficient deep water for the most liberal demands of commerce, but the inner harbor and channel are obstructed by bowlders, ledges, and shoals, dangerous and inconvenient to shipping, and the outer harbor or roadstead is open to the action of all southerly winds.

A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1887, page 506.

The first project formed for improvement was submitted January 20, 1871, and was based on the survey ordered by the act of July 11, 1870. (Report of the Chief of Engineers, 1871, page 869.)

This project proposed the removal of certain bowlders from the inner harbor, at a cost of $10,606.20, and the construction of a breakwater from Eastern Point over Dog Bar to Round Rock Shoal, at an estimated cost of $494,148.65.

On November 19, 1884, Maj. C. W. Raymond, Corps of Engineers, by order of the special Board of Engineers that was considering the subject of the Sandy Bay Breakwater, submitted a project for two breakwaters at the entrance of Gloucester Harbor, one to cost $752,000 on essentially the same site as that proposed in 1871; and a supplementary one through Norman's Woe Rock, to cost $607,000.

This project and estimate are published in the Chief of Engineers' Report for 1885, page 534.

On January 20, 1885, it was recommended, in accordance with act of July 5, 1884, that a survey of the inner harbor and of the reef off Muscle Point be made, and that Babson's Ledge be removed to 21 feet at mean low water. (Report of Chief of Engineers, 1885, page 541.) In

the annual report for this harbor for 1887 a general project for its improvement was submitted, based on the survey provided for by act of Congress approved August 5, 1886. (Chief of Engineers' Report, 1887, page 500.)

This project proposed to remove from the inner harbor 101½ cubic yards of rock known to exist, and to dredge 216,000 cubic yards, scow measurement, at an estimated cost of $65,000; and to construct the breakwater, recommended in the project of 1884, that extends from Eastern Point to Round Rock Shoal, at an estimated cost of $752,000.

The total appropriations for this harbor to date have been $40,000.

The amount expended to June 30, 1890, was $24,580.84.

The condition of the improvement June 30, 1890, was as follows:

Clam Rock had been reduced from 1 foot to 9⅓ feet at mean low water; Pinnacle Rock, from 8½ to 16½ feet mean low water; rock off Pew's Wharf, from 2 to 5 feet, mean low water; rocks off J. Friend's Wharf, from 13 to 17 feet, mean low water. All of the above rocks were reduced to the level of the surrounding bottom.

Babson's Ledge had been reduced from 11 to 14 feet mean low water; no work had been done on the breakwater.

Two channels had been dredged in Harbor Cove, approximately parallel to the heads of the wharves; the east channel was 550 feet long, the west 1,000 feet long; both were 40 feet wide and 10 feet deep at mean low water, except over a small ledge uncoyered by the dredging off Parmenter's Wharf.

All the ledges obstructing the channel in the main harbor between Harbor Cove and Pew's Wharf had been removed to the depth of the projected dredging in this part of the harbor.

The river and harbor act of September 19, 1890, appropriated $15,000 for this work. A project for the expenditure of this sum was submitted October 1, and approved October 6, 1890. It was to enlarge the improved channels in Harbor Cove, so that they should be each 140 feet wide, 10 feet deep at mean low water, and to complete the proposed improvement of the main harbor from its entrance near Fort Point to the steamboat wharf.

An advertisement inviting bids for the proposed work was issued under date of October 15, 1890. An abstract of the proposals received will be found in the annexed table.

On December 3, 1890, a contract was entered into with the Bay State Dredging Company to dredge 40,000 cubic yards, at 22 cents per yard. This contract expires December 31, 1891.

No operations have been in progress under this contract during the fiscal year, and the condition of the improvement at the date of this report remains essentially the same as on June 30, 1890.

To complete the improvement would require an appropriation of $40,000 for dredging, and $752,000 for the breakwater at Eastern Point. Of this amount $305,000 could be expended to advantage during the fiscal year ending June 30, 1893, in completing the proposed dredging and in commencing the breakwater.

The prospective advantages to commerce by the completion of the improvement are greater facilities and safety in the movement of vessels in the harbor, and a more secure anchorage for vessels seeking protection from southerly gales.

Gloucester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry.

The nearest light-houses are Ten Pound Island Light, in the harbor, and Eastern Point Light, at its entrance.

The accompanying commercial statistics for the fiscal year ending June 30, 1891, have been furnished by the collector of customs at Gloucester, Mass.

Money statement.

July 1, 1890, balance unexpended	$419.16
Amount appropriated by act approved September 19, 1890	15,000.00
	15,419.16
June 30, 1891, amount expended during fiscal year	67.76
July 1, 1891, balance unexpended	15,351.40
July 1, 1891, amount covered by uncompleted contracts	8,800.00
July 1, 1891, balance available	6,551.40
Amount (estimated) required for completion of existing project	792,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	305,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Gloucester Harbor, Massachusetts, opened November 22, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard measured in scows.	Price bid for removal of bowlders weighing over 3 tons each.	Remarks.
1	National Dredging Company, Wilmington, Del.	$0.23	$10.00	
2	Augustus R. Wright, Portland, Me	.28	8.00	
3	Bay State Dredging Company, Boston, Mass	.22	8.00	Lowest bid.
4	New England Dredging Company, Boston, Mass	.27	5.00	
5	Metropolitan Dredging Company, Lynn, Mass	.25	6.00	

Contract awarded to the Bay State Dredging Company with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $50,464.23 ; 1891, $19,800.

Shipping.	1890.		1891.	
	Number.	*Tons.*	*Number.*	*Tons.*
Entrances:				
Foreign	136	29,138	146	26,235
Domestic	22	2,149	30	6,000
Clearances:				
Foreign	123	16,130	138	23,500
Domestic	41	13,034	57	11,220

Imported.	1890.	1891.
	Tons.	*Tons.*
Coal	.....	45,000
Salt	28,324	30,000
Miscellaneous	.....	8,100

Total number of vessels boarded, 4,095.

B 7.

IMPROVEMENT OF HARBOR AT MANCHESTER, MASSACHUSETTS.

Manchester Harbor is situated about 5½ miles northeastward from the entrance of Salem Harbor, Massachusetts.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for 1888, Part I, page 466.

The outer sheltered roadstead contains approximately 300 acres, with 5 fathoms of water.

The entrance channel from the roadstead to Proctor Point is everywhere at least 100 feet wide, at least 6½ feet deep at mean low water, and is unobstructed.

At the "narrows," distant 1,400 feet inside of Proctor Point, the depth in the channel is reduced to 1½ feet at mean low water; thence to the town wharves, a further distance of 2,500 feet, no low-water channel exists. Near the town wharves the channel is crossed by the Boston and Maine Railroad (eastern division), on a bridge which is provided with a draw opening 28 feet wide.

The original project for the improvement of this harbor was submitted November 28, 1887. It was based on a survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel 60 feet wide, 4,000 feet long, and 4 feet deep at mean low water from Proctor Point to the town wharves, at an estimated cost of $14,300.

The total appropriations for this improvement are—

By the act of August 11, 1888	$2,500
By the act of September 19, 1890	5,000
Total	7,500

The expenditures to June 30, 1890, were $109.07, and the orginal condition of the improvement was unaltered.

On October 1, 1890, it was recommended that the funds available be expended in dredging a channel 25 feet wide and 4 feet deep at mean low water from Proctor Point to the railroad bridge, and this project was approved October 6, 1890.

An advertisement inviting bids for the proposed work was issued under date of October 15, 1890. An abstract of the bids received will be found in the annexed table.

On December 5, 1890, a contract was entered into with Messrs. Hamilton and Sawyer to dredge 22,000 cubic yards at 29 cents per yard. This contract expires December 31, 1891.

Operations under the contract of December 5, 1890, were commenced June 10, 1891, and during the fiscal year 7,316 yards were dredged. The condition of the improvement remains essentially as on June 30, 1890.

To complete the improvement will require an appropriation of $6,800, all of which could be expended during the fiscal year ending June 30, 1893.

Manchester Harbor is in the collection district of Gloucester, Mass., of which Gloucester is the port of entry. The nearest light-house is situated upon Bakers Island, 2½ miles from Proctors Point.

The existing commerce is nominal and the commercial statistics are included in Gloucester Harbor.

No increase in the tonnage of the harbor is apparent, and no new lines of water transportation have been established.

Money statement.

July 1, 1890, balance unexpended		$2,390.93
Amount appropriated by act approved September 19, 1890		5,000.00
		7,390.93
June 30, 1891, amount expended during fiscal year		212.40
July 1, 1891, balance unexpended		7,178.53
July 1, 1891, outstanding liabilities	$2,121.64	
July 1, 1891, amount covered by uncompleted contracts	4,258.36	
		6,380.00
July 1, 1891, balance available		798.53
Amount (estimated) required for completion of existing project		6,800.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		6,800.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Manchester Harbor, Massachusetts, opened November 22, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, as measured in scows.	Price bid for removal of bowlders weighing over 3 tons each.	Remarks.
1	Robert Hamilton, Chebeaque, Me.; Solomon Sawyer, Yarmouth, Me.	$0.29	$6.00	Lowest bid.
2	Boynton Bros., Boston, Mass	.33	6.00	
3	Bay State Dredging Company, Boston, Mass	.32	8.00	
4	Metropolitan Dredging Company, Lynn, Mass	.32	6.00	
5	Augustus R. Wright, Portland, Me	.32½	5.00	

Contract awarded to Messrs. Hamilton and Sawyer, with the approval of the Chief of Engineers.

B 8.

IMPROVEMENT OF HARBOR AT SALEM, MASSACHUSETTS.

Salem Harbor, Massachusetts, is 12 miles to the northward of Boston, Mass. Fort Pickering Light marks its entrance, between Winter Island on the west and Naugus Head on the east. The harbor is 1,750 feet wide at its entrance, and 5,500 feet long between the 12-foot contours of opposite shores. It contains a well sheltered, entirely unobstructed anchorage of about 110 acres, of a greater depth than 18 feet, mean low water. In front of the city are extensive flats, which makes long wharves necessary to reach deep water. The principal wharves of the city are located on "South River," a small stream which formerly drained a tidal basin on the southwestern side of the city. This basin is now practically filled up by city improvements. The river is 3,000 feet long to the head of navigation at South or Lafayette Street Bridge. It is crossed by a highway bridge, about one-fourth of a mile below the head of navigation, with a draw opening 31½ feet wide. The width of the river varies from 300 feet at its mouth to 150 feet at the head of navigation. The greatest depth of continuous low-water channel is 0.8 feet.

The original project for the improvəment of the harbor was submitted December 16, 1872. It proposed to dredge a channel 1,730 feet long, 300 feet wide, 8 feet deep at mean low water, at an estimated cost of $32,000. This project was essentially completed 1873–'75.

The present project for the improvement of the harbor was submitted December 2, 1889. It was based on a survey provided for in the river and harbor act of August 11, 1888. It proposed as follows:

To clean out the channel of approach to South River to the original dimensions as dredged in 1873–'75, viz, 300 feet wide at the entrance, and 150 feet wide off Derby Wharf Light, 8 feet deep at mean low water; to extend this channel with same depth, gradually reducing its width to 100 feet, to near the inner end of Derby Wharf, and from this point to the head of navigation excavate a channel 50 feet wide and 6 feet deep at mean low water.

The total length of the channel to be improved will be approximately 5,100 feet, and its excavation will require the removal of 85,000 cubic yards of material, at an estimated cost of $28,000.

To date the total appropriations for this harbor have been $39,000.

The total expenditure to June 30, 1890, were $25,000. At that date the channel improved in 1873–'75 had essentially preserved its original dimensions.

The river and harbor act of September 19, 1890, appropriated $14,000 for this improvement. A project for the expenditure of this amount was submitted October 1 and approved October 9, 1890. It proposed to dredge a channel 50 feet wide from deep water of the harbor to the head of navigation in "South River" of full projected depth.

An advertisement inviting bids for the proposed work was issued under date of October 15, 1890. An abstract of the bids received will be found in the annexed table.

On December 5, 1890, a contract was entered into with Mr. Augustus R. Wright to dredge 50,000 cubic yards at 22 cents per yard. This contract expires December 31, 1891. No operations were in progress under this contract during the fiscal year, and the condition of the improvement at the date of this report remains essentially the same as on June 30, 1890.

To complete the present project would require an appropriation of $14,000, all of which could be expended during the fiscal year ending June 30, 1893.

Salem Harbor, including South River, Massachusetts, is in the collection district of Salem, Mass., of which Salem is the port of entry. The nearest light-house is Derby Wharf Light, Salem Harbor, Mass.

The accompanying commercial statistics for the fiscal year ending June 30, 1891, have been furnished by the collector of customs at Salem, Mass.:

Money statement.

Amount appropriated by act approved September 19, 1890	$14,000.00
June 30, 1891, amount expended during fiscal year	73.65
July 1, 1891, balance unexpended	13,926.35
July 1, 1891, amount covered by uncompleted contracts	11,000.00
July 1, 1891, balance available	2,926.35
Amount (estimated) required for completion of existing project	14,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	14,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Salem Harbor, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard as measured in scows.	Price bid for removal of boulders weighing over 3 tons each.	Remarks.
1	New England Dredging Company, Boston, Mass	$0.23	$10.00	
2	Bay State Dredging Company, Boston, Mass	.25	10.00	
3	Metropolitan Dredging Company, Lynn, Mass	.20¼	10.25	
4	Augustus R. Wright, Portland, Me	.22	5.00	Lowest bid.
5	Robert Hamilton, Chebeague, Me., and Solomon Sawyer, Yarmouth, Me.	.33	6.00	

Contract awarded to Augustus R. Wright with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected 1868, $29,687.14; 1891, $6,416.80.

Shipping.	1868.		1891.	
	No.	*Tons.*	*No.*	*Tons.*
Entrances:				
Foreign	100	225,000	117	15,168
Domestic	598		1,659	456,824
Clearances:				
Foreign	.....	.....	93	13,253
Domestic	.....	.....	.....	.....

Imported, 1891—

	Tons.
Coal	5,890
Lumber	3,424
Miscellaneous	2,731

Vessels from 8 to 21 feet draft frequent the port.

B 9.

IMPROVEMENT OF HARBOR AT LYNN, MASSACHUSETTS.

Lynn Harbor is situated 9 miles northeast from Boston. It is 1 by 2 miles approximately in extent, the greater part of which is dry at low water.

It is protected on the north and west by the mainland and on the east by Nahant Beach, and its entrance, 2 miles wide, into Massachusetts Bay, is on the south side.

A plan of the harbor, showing the projected improvement, was published in the Annual Report of the Chief of Engineers for 1884, part I, page 532.

Before improvement, three narrow and crooked channels of approach to the wharves existed, in each of which there was about 6 feet depth at mean low water. The mean rise or fall of the tide is 9.3 feet.

The western channel leads to the Point of Pines and the mouth of Saugus River. The main ship-channel is entered between White and Lobster Rocks, and connects about 3,600 feet northward with the Black Rock Channel, which is the most eastern near Nahant Beach.

The project for improvement was adopted in 1884. It provides for the excavation of a channel 200 feet wide and 10 feet deep at mean low water, from a point near and east of the White Rocks, to deep water opposite Little Nahant, a distance of 3,610 feet; this is called the outer improved channel, and is merely a rectification and deepening of the main ship-channel. The combined main ship and Black Rock channels are sufficient for the purposes of commerce for the next 2,500 feet. Then commences the inner improved channel, which is projected 6,450 feet long, 200 feet wide, and 10 feet deep at mean low water. It extends from deep water, opposite Sand Point, to the harbor commissioners' line, and follows very closely in direction the extension of the united main ship and Black Rock channels.

On September 24, 1888, this project was modified. It was then proposed to extend the main ship-channel 400 feet within the harbor line and to excavate at its inner end a basin 500 by 300 feet in area, 10 feet deep at mean low water.

It is supposed that the inner channel will need to be dredged occasionally to maintain its width and depth; but a training wall, about 6,000 feet long, has been proposed to aid in keeping the outer channel open, if experience shall show it to be necessary.

This wall is to start from the shore at "Little Nahant" and is to cross the Black Rock Channel. Its outer position is to be parallel to the outer improved channel.

The cost of the original project was estimated to be $145,000. This estimate was revised in 1885, and then made $157,000, to provide for an increased amount of dredging, found to be necessary during the progress of the work, to round off the junctions of the natural channel with the dredged channel, to provide flatter slopes to the sides of the cuts than was originally designed, and also to provide funds for necessary surveys during the progress of the work.

The modifications proposed September 24, 1888, were estimated to cost $25,000, which would make the total cost of the improvement $182,000.

The total appropriations for this harbor to date have been $91,000.

The amount expended to June 30, 1890, was $75,415.32.

On June 30, 1890, the outer channel had been completed as proposed, 3,610 feet long, 200 feet wide, 10 feet deep at mean low water; the inner channel was 6,450 feet long, 10 feet deep at mean low water, 150 feet wide, or 50 feet less than is proposed. The basin was 125 feet wide, 500 feet long, 10 feet deep at mean low water, connected with the main ship-channel at the harbor line by a cut 100 feet wide, 400 feet long, 10 feet deep at mean low water.

The river and harbor act of September 19, 1890, appropriated $15,000 for this improvement.

The project for the expenditure of this sum was submitted October 1, and approved October 6, 1890. It was to complete the interior basin.

An advertisement inviting bids for the proposed work was issued under date of October 15, 1890.

An abstract of the proposals received will be found in the annexed table.

On December 15, 1890, a contract was entered into with the New England Dredging Company to excavate 40,000 cubic yards, at 18 cents per yard. This contract expires December 31, 1891.

No operations were in progress under this contract during the fiscal year.

At the date of this report the condition of the improvement remains essentially the same as on June 30, 1890.

To complete the improvement will require an appropriation of $91,000, and of this amount $50,000 could be expended to advantage during the fiscal year ending June 30, 1893.

Lynn is a port of entry in the collection district of Marblehead, Mass. The nearest light-house is Egg Rock (Nahant) Light, 3 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1891, have been furnished by the collector of customs at Marblehead, Mass.:

Money statement.

July 1, 1890, balance unexpended	$584.68
Amount appropriated by act approved September 19, 1890	15,000.00
	15,584.68
June 30, 1891, amount expended during fiscal year	197.04
July 1, 1891, balance unexpended	15,387.64
July 1, 1891, amount covered by uncompleted contracts	7,200.00
July 1, 1891, balance available	8,187.64
Amount (estimated) required for completion of existing project	91,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	50,000.00

Abstract of proposals for dredging in Lynn Harbor, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, measured in scows.	Price bid for removal of bowlders weighing over 3 tons each.	Remarks.
1	Augustus R. Wright, Portland, Me	$0.18¾	$5.00	
2	National Dredging Company, Wilmington, Del	.25	10.00	
3	Metropolitan Dredging Compamy, Lynn, Mass	.18¼	10.25	
4	Bay State Dredging Company, Boston, Mass	.25	10.00	
5	New England Dredging Company, Boston, Mass	.18	10.00	Lowest bid.

Contract awarded to the New England Dredging Company with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $3,509.60; 1891, $4,855.96.

Shipping.	1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*
Entrances:				
Foreign	28	2,692	18	1,878
Domestic	489	97,800	453	95,130
Clearances:				
Foreign	38	4,735	21	2,702
Domestic	477	95,400	447	93,870

Imported.	1890.	1891.	Imported.	1890.	1891.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Coal	146,000	147,400	Lumber	16,496	12,380
Iron	1,400	750	Miscellaneous	16,246	22,786

Total number of vessels visiting the port, 471; average draft, 13 feet.

B 10.

IMPROVEMENT OF HARBOR AT WINTHROP, MASSACHUSETTS.

This harbor is situated in the northeastern part of Boston Harbor, immediately westward of Winthrop Head.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, part 1, page 470.

The harbor contains, approximately, 350 acres, all of which is dry at low tide, except a short, narrow, crooked slough east of Snake Island. To the town wharf no low-water channel exists. The mean range of tides is 9.4 feet.

The nearest deep-water channel of Boston Harbor is known as the "Back" Channel, and it extends from Point Shirley to East Boston. It has from 9 to 16 feet depth at low tide. The town wharf is distant from this "Back" Channel 3,900 feet.

The original project for the improvement of this harbor was submitted November 28, 1887; it was based on the survey provided for in the river and harbor act of August 5, 1886.

The project proposes to excavate a straight channel 3,900 feet long, 50 feet wide, and 6 feet deep at mean low water, from the "Back" Channel to "Rice's" Wharf, at an estimated cost of $17,600.

For this improvement the following amounts have been appropriated:

By the act of August 11, 1888	$1,000
By the act of September, 19, 1890	5,000
Total	6,000

No part of this sum had been expended on June 30, 1890, and the original condition remained unaltered.

On October 1, 1890, it was recommanded that the funds available be expended in dredging a channel 35 feet wide and 3 feet deep at mean low water from deep water to "Rice's" wharf. This was approved and on October 15, 1890, an advertisement was issued calling for bids for the proposed work.

An abstract of the proposals received will be found in the annexed table.

On December 10, 1890, a contract was entered into with Messrs. Boynton Bros. to dredge 20,000 cubic yards, at 24 cents per yard. Operations under this contract were commenced in May, 1891, and were satisfactorily completed June 30, 1891, by the removal of 20,060 yards.

The improved channel is now 3 feet deep at mean low water, 3,900 feet long, and 35 feet wide. Opposite "Rice's" wharf it is 50 feet wide.

The beaches and headlands protecting this harbor on the east were seriously abraded by the storms of the winter 1888–'89, this abrasion has been conntinued and they will soon require protection, not only to secure this minor harbor, but to prevent injury to the main harbor of Boston. To complete the improvement will require an appropriation of $11,600, all of which could be expended during the fiscal year ending June 30, 1893.

Winthrop Harbor, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry; the nearest light-house is situated upon Deer Island Point, Boston Harbor, Massachusetts.

The existing commerce is nominal, and commercial statistics are included in Boston Harbor, Massachusetts.

No increase in the tonnage of the harbor is apparent, and no new lines of water transportation have been established.

Money statement.

July 1, 1890, balance unexpended	$1,000.00
Amount appropriated by act approved September 19, 1890	5,000.00
	6,000.00
June 30, 1891, amount expended during fiscal year	2,381.18
July 1, 1891, balance unexpended	3,618.82
July 1, 1891, outstanding liabilities	2,944.82
July 1, 1891, balance available	674.00
Amount (estimated) required for completion of existing project	11,600.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	11,600.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposal for dredging in Winthrop Harbor, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard measured in scows.	Price bid for removal of bowlders weighing over 3 tons each.	Remarks.
1	Augustus R. Wright, Portland, Me	$0.30	$5.00	
2	Boynton Bros., Boston, Mass	.24	6.00	Lowest bid.
3	Metropolitan Dredging Company, Lynn, Mass	.28½	10.25	
4	Robert Hamilton, Cheleague, Me., and Solomon Sawyer, Yarmouth, Me.	.30	6.00	
5	Bay State Dredging Company, Boston, Mass	.28	10.00	

Contract awarded to Boynton Bros. with the approval of the Chief of Engineers.

B 11.

IMPROVEMENT OF HARBOR AT BOSTON, MASSACHUSETTS.

Boston Harbor consists essentially of an inner and an outer harbor, united by a deep water way, and each accessible from the sea by a distinct channel, widening into a deep and spacious roadstead.

1. *Inner harbor.*—This harbor lies to the north and westward of Long Island, and has deep water and good anchorage in the President Roads, seaward of Lower Middle Bar, and also near the city westward of Upper Middle Bar.

Four rivers discharge their waters into this basin—the Charles, Mystic, and Chelsea Rivers from the north, and the Neponset from the south. The direct entrance from the sea is by Broad Sound.

2. *Outer harbor.*—This harbor lies to the southward of Long Island, and has a fine anchorage in Nantasket Roads, as well as in Hingham Bay, a well-sheltered harbor southeast of Peddock Island. It connects with the inner harbor by the main ship channel through the "Narrows," and by secondary channels east and west of Long Island. It is reached from the sea by Nantasket Roads, which lie south of

George and Great Brewster Islands, and is marked at the sea entrance byBoston Light.

Weymouth and Weir Rivers empty into the outer harbor.

Both the inner and outer harbors are subdivided into several minor harbors, and contain many islands, which shelter the anchorages from winds and storm waves.

The range of tides at the navy-yard is 9.8 feet, and at the entrance to the outer harbor 9.4 feet.

A sketch of the harbor was printed in the Annual Report of the Chief of Engineers for the year 1888, page 454.

The object of the improvement is, first, to *preserve* the harbor by protecting the islands and headlands; and, second, to *improve* it, by widening, deepening, and straightening the channels.

The projects adopted for this purpose since 1866 have been mainly in accordance with the recommendations of the United States commissioners whose labors terminated during that year.

The works of preservation consist of sea walls, aprons, jetties, etc., which protect the shores of the islands and headlands, prevent additional wash into the channels, control the tidal scour, and preserve the full height of anchorage shelter for vessels in the roadsteads.

The works of improvement have been by dredging and blasting.

The total expenditures to June 30, 1890, were $1,728,360.66.

WORKS OF PRESERVATION.

Point Allerton.—This headland at the southeasterly entrance of the harbor, is protected by a granite sea wall 1,202 feet in length, completed in 1873. Its concrete foundation for a distance of 1,005 feet is protected by an apron and eight short jetties of granite rubblestone.

No work was done on it during the fiscal year.

Its condition June 30, 1891, is as follows:

The wall is generally in good order, although some of its joints should be repointed. The bluff protected by this wall is not fully covered from storm action, and the sea wall should be extended westward for a distance of at least 150 feet, and the foundation of the extension should be protected with riprap.

This is estimated to cost $15,000.

Great Brewster Island.—This island is on the north side of the main ship channel near the entrance. It is protected by a granite sea wall 2,840 feet loug, which was completed in 1869.

On June 30, 1891, it was in fair order. Many of the joints require repointing, and some of the coping course should be reset.

These necessary repairs are estimated to cost $10,000, and were commenced during the latter part of June, 1891.

Georges Island.—Its northern and eastern shores are protected by a granite sea wall 2,150 feet long. West of this wall a riprap improvement extends for 450 feet, and south of it another 600 feet long. The sea wall and southern riprap were built about 1835. The western riprap was built in 1884–'85. No work was done on the wall or ripraps during the year, and they are in good order at the date of this report. The unprotected western shore line of the island in front of the Government buildings was considerably abraded; the high-water line had been moved back in places nearly 25 feet. This shore line should be protected by a light sea wall, 1,400 feet long, at a cost of $35,000.

Lovells Island.—The western shore of this island is protected by a rubblestone apron, 975 feet long, built in 1873, and repaired and ex-

tended in 1884; the northern shore is covered by a granite sea wall 750 feet long, built in 1843, and the eastern shore is protected by a granite sea wall 800 feet long, built in 1869, and repaired in 1879 and 1886, and by two rubblestone aprons, one between the northern and eastern sea walls, 1,440 feet long, and the other south of the east sea wall, 1,330 feet long.

No operations were in progress during the fiscal year.

The condition of the work on June 30, 1891, was as follows: The sea walls and the ripraps on the eastern shore were in good order; the western shore riprap had been undermined in places and had fallen down, but it needed no immediate repairs.

Gallops Island.—The western, northern, and eastern shores of this island are protected by a granite sea wall 2,085 feet long, completed in 1889, and by a rubblestone apron, completed in 1884, 3,050 feet long, which also covers the foundation of the sea wall.

On June 30, 1891, operations were in progress in extending the sea wall 300 feet to the southeast. The granite ashlar, and shell-stone paving for this extension was purchased by contract with the Rockport Granite Company. The wall is being built by hired labor, and, at the date of this report, about 70 feet of foundation and two lower courses of the wall were completed.

Deer Island.—Three prominent bluffs of this island are protected by granite sea walls, originally built about 1827. The north head-wall is 1,740 feet long; the middle head-wall is 840 feet, and the south head-wall is 380 feet long. In 1865 and 1869 these walls were partly rebuilt, and in the weakest places were backed with concrete. They were all originally built dry, and from time to time have required repairs.

During the fiscal year repairs were made to the north and middle head-walls. The joints were repointed, and about 100 square yards of shell stone paving were reset.

The amount expended during the year was $2,193.93, and at the date of this report the walls were in fair order.

Long Island.—The north head of this island is protected by a granite sea wall 2,081¾ feet long, completed in 1874. Part of the foundation of the sea wall and of the beach at both its ends are protected by a rubblestone apron, aggregating 1,375 feet in length. This apron was built in 1874, and extended in 1884. No operations were in progress during the fiscal year. On June 30, 1891, the wall needed to be repointed in places, the riprap was in fair order and should be extended about 250 feet, to more fully protect the southeastern shore. These repairs and extensions are estimated to cost $3,000, and will be made during the coming year.

Rainsford Island.—The north head of this island is protected by a dry granite sea wall 1,500 feet long, originally built about 1840 and extensively repaired in 1884–'85. No work was done during the year, and on June 30, 1891, the wall was in good order and needed no repairs.

Castle Island.—The north and part of the east and west shores of this island are protected by a dry granite sea wall 3,300 feet long, built in 1835. A light riprap extends along the east shore 300 feet from the end of the wall; this was built in 1865. No work was done during the year, and on June 30, 1891, the riprap was in good order. The sea wall needed repairs on the north face a short distance west of the wharf, where the foundation has been undermined and the wall has settled. About 100 running feet of the wall has been thus injured, and this length of the wall needs taking down and rebuilding, at a cost of $1,000.

Governors Island.—The shore line of this island has never been pro-

tected. The east and south bluffs, however, should be covered by sea walls to prevent additional abrasion, not only to secure the sites of the important heavy batteries which occupy these bluffs, but also to prevent injury to the main ship channel.

The east bluff wall should be 500 feet long, and is estimated to cost $30,000; the south bluff wall should be 1,800 feet long, and will cost $50,000.

WORKS OF IMPROVEMENT.

The main ship channel.—Before improvement it had a least width of 100 feet and a least depth of 18 feet, at mean low water. The general project for its improvement was submitted in 1867. It proposed to dredge the channel 23 feet deep at mean low water, 1,000 feet wide at the upper and lower middles and 685 feet at the narrows.

In 1870 the proposed width at the narrows was reduced to 625 feet, and at the anchorage shoal, in the inner harbor, increased to 1,100 feet.

In 1887 it was proposed to straighten the passage through the "narrows" by cutting off a spur that projected from Lowells Island, which was estimated to contain 20,000 cubic yards.

On June 30, 1890, the condition of the main ship channel was as follows: It was 23 feet deep at mean low water, 1,100 feet wide west of the upper middle, 750 feet wide at the upper middle, 1,000 feet wide west of the lower middle, 625 feet wide at the narrows and 475 feet wide opposite the west end of Brewster Spit.

In effecting this improvement dredging and blasting was done at the following places:

At *Nash Rock Shoal.*—During the years 1876–'78, 365 cubic yards of ledge were removed.

At Kelleys Rock and Shoal.—During the years 1869–'79, 222 cubic yards of ledge were removed.

Tower, Corwin, and Channel Rocks were removed during the years 1867–'75. They aggregated 608¾ cubic yards.

From the West End of Brewster Spit, during the years 1874–'76, 29,226 cubic yards of sand and gravel were dredged, and 95½ cubic yards of ledge were removed.

At Lovell Island, from the southeast and southwest points, 267,294½ cubic yards were dredged during the years 1867–'77, and from a spur between these points 3,430 cubic yards were dredged in 1888.

At Castle Island Bar and Shoal, opposite the lower middle, during the years 1880–'83, 36,957 cubic yards were dredged and 20 tons of rock were removed.

At the Lower Middle, in 1874–'75, State and Palmyra rocks were removed; they aggregate 62 cubic yards. In 1887–1889 71,892 cubic yards were dredged from this shoal and 375 cubic yards of ledge removed.

At the Upper Middle, during the years 1870–'76, 268,278½ cubic yards were dredged and 118 cubic yards of ledge were removed; in 1880–'90 146,182 cubic yards were dredged and 111 cubic yards of ledge were removed.

At Anchorage Shoal, during the years 1879–'82, 65,327 cubic yards were dredged.

At Man-of-War Shoal 85,917 cubic yards were dredged in the years 1878–'80.

At Mystic River Shoal, during the years 1879–'82, 82,082 cubic yards were dredged.

The river and harbor act of September 19, 1890, appropriated $145,000 for this improvement—

Of which sum $7,000 to be used in widening Nantasket Beach Channel; $25,000 in extending main ship channel from its termination at the southeast corner of Grand Junction Wharf eastwardly toward Jeffrey Point, and $20,000 for continuing improvement of Charles River: *Provided*, that no expenditure of said $20,000 shall be made until the draws in the Arsenal Street and Market Street bridges shall be made to conform to the projected channel without cost to the United States—

leaving for the general improvement and preservation of the harbor $93,000.

This amount it was proposed to expend as follows: Complete the channel between Nix Mate and Long Island at a cost of $25,000. Repair the sea wall at Great Brewster Island at a cost of $10,000. Extend the sea wall at Gallop Island 300 feet, at a cost of $12,000. Add to the riprap at Long Island, at a cost of $3,000. Widen the main ship channel at Brewster Spit so that it would be 625 feet wide, at a cost of $15,000, and reserve the residue of the appropriation for probably necessary repairs to the works of preservation and for the removal of ledges uncovered by the dredging.

Advertisements were issued for the proposed works of dredging and the delivery of material needed for the extension of the Gallop Island sea wall. An abstract of the bids received will be found in the annexed tables.

On June 30, 1891, the main ship channel is 23 feet deep at mean low water, 1,100 feet west of the Upper Middle, 750 feet wide at the Upper Middle, 1,000 feet wide at the Lower Middle, and at least 625 feet elsewhere, except off Brewster Spit, where it is 550 feet approximately.

The following tributary channels have been improved by dredging and blasting:

1. CHARLES RIVER.

This river enters the inner harbor near the navy-yard at Charlestown.

Before improvement the natural channel had, as far up as Western Avenue Bridge, $4\frac{3}{4}$ miles from its mouth, 7 feet depth at mean low water, except in several places, covering about $1\frac{1}{4}$ miles in extent below Brookline Street Bridge, where the depth varied from $4\frac{1}{2}$ to 7 feet.

From Western Avenue Bridge to Arsenal Street Bridge ($2\frac{1}{2}$ miles) there was a depth of 4 feet mean low water; thence to Market Street Bridge ($\frac{3}{4}$ mile) $2\frac{1}{4}$ feet mean low water; and thence to the dam at the head of tide-water ($1\frac{3}{4}$ miles) a depth varying from 0 to $9\frac{1}{2}$ feet above mean low water. The mean rise or fall of the tides is 10 feet. A sketch showing the river was published in the Annual Report of the Chief of Engineers for 1884, page 512.

The project for the improvement of this river consists in straightening, widening, and deepening the natural channel, so that it should be from its mouth to Western Avenue Bridge 7 feet deep at mean low water and 200 feet wide; from Western Avenue Bridge to Market Street Bridge, 6 feet deep at mean low water, and 80 feet wide; thence to the dam at the head of tide water, 60 feet wide and 2 feet deep at mean low water.

The estimated cost of this improvement was originally $85,000. A revised estimate was submitted in 1881 of $125,000.

The total appropriations for this improvement to date have been $77,500.

The expenditures to June 30, 1890, were $57,500. No operations were in progress during the fiscal year, and the condition of the im-

provement June 30, 1891, is as follows: The projected channel has been completed from the mouth of the river to Arsenal Street Bridge (7¼ miles); work was stopped at this point for the reason that the piers and draws of this bridge do not conform to the projected channel above it. In effecting this improvement 127,971 cubic yards were dredged during the years 1880–1884.

2. FORT POINT CHANNEL.

This channel is situated between the eastern shore of Boston proper on the one side and the reclaimed and improved flats of South Boston on the other side. It connects the tidal basin of South Bay, which has an area of 250 acres, with Boston Inner Harbor, is fast becoming the center of the city's most extensive shipping trade, and is the most important branch of the main ship-channel. Fort Point Channel is 1¼ miles long.

Before improvement the least depth at mean low water was 12 feet at its entrance and 17 feet above Congress Street Bridge.

That part of it which it is proposed to improve is spanned by bridges at Congress street, Mount Washington avenue, and at an intermediate point. These bridges have conveniently located draw openings, but the draw piers of the railroad bridge must be strengthened or reconstructed before the improvement can be extended past them, and the width of the draw increased to that of the other bridges above and below it.

The project for this improvement was submitted January 27, 1885 (Annual Report Chief of Engineers, 1885, page 545).

It proposed the excavation of a channel 175 feet wide and 23 feet deep at mean low water from the entrance to near Federal Street Bridge, a distance of 4,100 feet, and was estimated to cost $100,000, the railroad bridge to be reconstructed at the expense of the owners.

By the river and harbor act of August 5, 1886, the sum of $18,750 was appropriated for the improvement of that part of the channel lying below Congress Street Bridge.

The total expenditures to June 30, 1890, were $18,750.

No operations were in progress during the year and the condition of improvement June 30, 1891, is as follows: The channel had been dredged as proposed from its entrance to Congress Street Bridge, a distance of 1,900 feet; 94,211 cubic yards were removed in effecting this improvement during the year 1887.

To complete the improvement as proposed to Federal Street Bridge will cost $60,000, and this sum could be expended to advantage during the fiscal year ending June 30, 1892, if the railroad draw shall have been properly reconstructed.

3. HINGHAM HARBOR.

(See separate report).

4. NANTASKET BEACH CHANNEL.

This is a small channel along the east side of Hingham or Hull Basin. It leads to a wharf on the west side of the heel of Nantasket Beach, about 12 miles from Boston.

Before improvement it was approximately 100 feet wide, and had a depth of at least 11 feet, except at the eastern end, 1,500 feet from the wharf, where the width was reduced to 40 to 50 feet and the depth to less

than 8 feet.' It was circuitous and obstructed by bowlders at the mouth of Weir River and by a ledge near the wharf.

The project adopted in 1880 was to widen and deepen the channel from the mouth of Weir River to the steamboat wharf, so that it would be 100 feet wide and 9½ feet deep at mean low water, to remove a few bowlders at the mouth of Weir River, and to remove the ledge near the wharf.

The total appropriations and allotments for this work to date are $21,067.80, of which $14,067.80 had been expended to June 30, 1890.

The condition of the improvement June 30, 1890, was as follows: The projected channel had been completed by the removal of 50,947 cubic yards of material dredged and 54 cubic yards of ledge blasted during the years 1881–1883 and 1890.

On December 3, 1890, a contract was entered into with Charles W. Lampee to dredge 20,000 cubic yards from this channel, making it 150 feet wide.

Operations under this contract were commenced in March and finished in April, 1891. Nineteen thousand seven hundred and twenty-four cubic yards were removed, and the channel leading to the steamboat wharf is at least 150 feet wide, 9½ feet deep at mean low water, except over a ledge uncovered by the dredging near the wharf, which is estimated to contain 150 cubic yards.

Tonnage of the channel in—

	Tons.
1874	390,226
1889	654,920
1890	703,340

5. CHANNEL BETWEEN NIX'S MATE AND LONG ISLAND.

This is a channel through the bar which extends from the north head of Long Island to Nix's Mate Shoal. Previous to the improvement there was 4½ feet depth of water on the bar at mean low tide.

The project for the improvement was adopted in 1883. It was to dredge a channel 200 feet wide, 12 feet deep at mean low water, and about 550 feet long. In 1887 it was recommended that the axis of the cut be shifted 30 degrees to the westward, and that it be widened to 300 feet, 15 feet deep at mean low water. The original project was estimated to cost $9,000. The project of 1887 was estimated to cost $25,000 additional. No specific appropriation has been made for this work.

The expenditures on it to June 30, 1890, from the appropriation for the improvement of Boston Harbor, were, for dredging, $9,551.76.

On June 30, 1890, the condition of this improvement was as follows:

The original project had been completed by the removal of 19,899½ cubic yards of material dredged during the year 1884.

The latest survey shows that the channel has retained its full width and deepened throughout 1 foot approximately. The channel has been of the greatest service to the vessels and boats which ply to the wharves of the lower harbor, and has conferred a great benefit upon commerce by diminishing the number of passages of medium craft through the "Narrows," where the channel is narrow and overburdened and the currents transverse and irregular. These advantages will be largely increased so soon as the modified project of 1887 shall have been completed.

On December 15, 1890, a contract, which expires December 31, 1891, was entered into with the New England Dredging Company to dredge

70,000 cubic yards from this channel, and thus complete it in accordance with the project of 1887.

No operations were in progress under this contract during the year.

6. BROAD SOUND.

An obstruction called Barrel Rock, lying on the north side of the Broad Sound Channel, was removed in 1869. It contained 116 cubic yards.

7. HARBOR LINES.

Examinations and surveys have been made for the Harbor-Line Board, and the preparation of plans for the Board's use has been continued during the year.

8. EXTENSION OF MAIN SHIP CHANNEL TOWARD JEFFREY POINT.

A project for the improvement of this part of the main ship channel was submitted December 2, 1890.

It was to dredge a channel 400 feet wide from Grand Junction Wharf to just east of the Simpson Patent Dry Docks, and 18 feet deep at mean low water; thence gradually narrowing the channel to 250 feet, and decreasing the depth of water to 15 feet to a junction with the same depth off Jeffrey Point. The original depth of this part of the channel did not exceed 12 feet at mean low water.

The river and harbor act of September 19, 1890, appropriated $25,000 for this improvement, and it was proposed and approved to expend this sum in making the channel, in partial completion of the project, 275 feet wide to just east of the dry docks, and thence in accordance with the project.

An advertisement calling for bids for this work was issued under date of December 20, 1890. An abstract of the bids received will be found in the annexed table.

On January 29, 1891, a contract which expires December 31, 1891, was entered into with Mr. Augustus R. Wright to dredge from this channel 129,000 cubic yards.

No operations were in progress under this contract during the fiscal year, and the condition of the improvement remains unaltered.

On December 5, 1890, a contract was entered into with Mr. Augustus R. Wright to dredge 28,000 cubic yards from the west end of Brewster Spit, and thus widen the main ship channel at this point from 475 feet to 625 feet.

Operations were commenced under this contract June 1, 1891, and at the close of the fiscal year 16,440 cubic yards had been removed, and the channel widened to 550 feet, approximately.

The contract was to expire June 30, 1891, but at the request of the contractor it has been extended 30 days.

Recapitulation of amounts which could be expended to advantage during the fiscal year ending June 30, 1893.

Extension of Point Allerton sea wall	$15,000
Sea wall for George Island	35,000
Sea wall for Governor Island	80,000
Widening of main ship channel at "Upper Middle"	200,000
Completion of Fort Point Channel	60,000
Total	390,000

The several works completed and projected for the improvement of this harbor are located in the collection district of Boston and Charlestown, Mass. Boston is the port of entry.

The accompanying commercial statistics for the fiscal year ending June 30, 1890, have been furnished by the collector of customs at Boston, Mass.

Money statement.

July 1, 1890, balance unexpended		$27,747.84
Amount appropriated by act approved September 19, 1890		145,000.00
		172,747.84
June 30, 1891, amount expended during fiscal year		15,921.72
July 1, 1891, balance unexpended		156,826.12
July 1, 1891, outstanding liabilities	$6,621.53	
July 1, 1891, amount covered by uncompleted contracts	37,023.40	
		43,644.93
July 1, 1891, balance available		113,181.19
Amount (estimated) required for completion of existing project		390,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		390.000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Nantasket Beach Channel, Boston Harbor, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, measured in scows.	Price bid for removal of bowlders of over 3 tons each.	Remarks.
1	Augustus R. Wright, Portland, Me	$0.28½	$5.00	
2	Boynton Brothers, Boston, Mass	.27	6.00	
3	Charles W. Lampee, Boston, Mass	.25	10.00	Lowest bid.
4	Metropolitan Dredging Company, Lynn, Mass	.25¾	10.25	

Contract awarded to Charles W. Lampee, with the approval of the Chief of Engineers.

Abstract of proposals for dredging from Nix's Mate Channel, Boston Harbor, Massachusetts, opened November 24, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, as measured in scows.	Price bid for removal of bowlders weighing over 6 tons each.	Remarks.
1	Bay State Dredging Company, Boston, Mass	$0.25	$8.00	
2	Metropolitan Dredging Company, Lynn, Mass	.30	10.00	
3	New England Dredging Company, Boston, Mass	.19¼	10.00	Lowest bid.
4	Augustus R. Wright, Portland, Me	.21	8.00	

Contract awarded to New England Dredging Company, with the approval of the Chief of Engineers.

Abstract of proposals for dredging from the west end of Brewster Spit, Boston Harbor, Massachusetts, opened November 24, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, as measured in scows.	Price bid for removal of bowlders weighing over 6 tons each.	Remarks.
1	Bay State Dredging Company, Boston, Mass	$0.18	$5.00	
2	Metropolitan Dredging Company, Lynn, Mass	.19	5.00	
3	Boynton Bros., Boston, Mass	.22	10.00	
4	Augustus R. Wright, Portland, Me	.14	4.00	Lowest bid.
5	New England Dredging Company, Boston, Mass	.21¾	5.00	

Contract awarded to Augustus R. Wright, with the approval of the Chief of Engineers.

Abstract of proposals for the delivery of granite ashlar at Gallops Island, Boston Harbor, Massachusetts, opened December 15, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for ashlar per cubic yard.	Price bid for shell-stone paving.	Aggregate price bid.	Remarks.
1	Pigeon Hill Granite Company, Rockport, Mass.	.....	.....	$4,991.00	
2	George Willet Andrews, Biddeford, Me	.....	.....	4,337.00	
3	James J. Vernon, Lanesville, Mass	.....	.....	4,100.00	
4	Blue Hill Granite Company, Blue Hill, Me	.....	.....	11,552.00	
5	Edwin Canney, Pigeon Cove, Mass	$12.97	$183.75	4,374.75	
6	Rockport Granite Company, Rockport, Mass	.....	.....	3,917.00	Lowest bid.
7	Cape Ann Granite Company, Boston, Mass	.....	.....	4,894.00	
8	Thomas A. Rowe, Boston, Mass	.....	.....	4,360.90	

Contract awarded to Rockport Granite Company with the approval of the Chief of Engineers.

Abstract of proposals for dredging from the main ship channel, Boston Harbor, Massachusetts, opened January 20, 1891, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, measured in scows.	Price bid for removal of bowlders of over 6 tons each.	Remarks.
1	Charles H. Souther, Boston, Mass	$0.21	$10.00	
2	Boynton Bros., Boston, Mass	.23	8.00	
3	Augustus R. Wright, Portland, Me	.17	2.00	Lowest bid.
4	A. K. Stone, Roxbury, Mass	.23	.....	

Contract awarded to Augustus R. Wright, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected 1890, $19,407,928.57; 1891, $18,038,772.34.

Shipping.	1890.		1891.	
	Number.	*Tons.*	*Number.*	*Tons.*
Entrances:				
Foreign	2251	1,404,867	2474	1,502,759
Domestic	.....	.....	.....	.....
Clearances:				
Foreign	2267	1,208,505	2376	1,226,378
Domestic	.....	.....	.....	.....

	1890.	1891.
Importations:		
Merchandise	$62,876,666	$71,212,614
Coin and bullion	49,314	10,238
Exportations:		
Foreign merchandise	836,989	300,564
Domestic—		
Merchandise	70,364,955	76,731,823
Coin and bullion	.....	1,250,000

B 12.

IMPROVEMENT OF WEYMOUTH RIVER, MASSACHUSETTS.

Weymouth (Fore) River, Massachusetts, tributary to Hingham Bay, Boston Harbor, on the southwest, is one of the most important water courses on the south coast of Massachusetts Bay. It is navigable at low-water mark for vessels not to exceed 18 feet draft 4 miles from its mouth; and for a further distance of 3 miles, to the head of navigation, at least 3 feet depth is found at mean low water.

The original project for its improvement was submitted December 2, 1889. It was based on the survey provided for by the act of August 11, 1888, and proposed to improve the natural channel of the river by dredging, so that 6 feet depth at mean low water can be carried to the head of navigation in a channel 100 feet wide to near the wharves at Weymouth Landing, thence to Braintree Bridge, 80 feet wide, and above the bridge 50 feet wide, with increased width at each turn to facilitate the movement of vessels. The total length of channel to be improved is 7,000 feet approximately, and the cost is estimated to be $40,000.

The river and harbor act of September 19, 1890, appropriated $10,000 for this improvement. A project for the expenditure of this amount was submitted October 1, and approved October 9, 1890. It proposed to dredge a channel 6 feet deep at mean low water, 40 feet wide, to Braintree Bridge, and 25 feet wide above said bridge to the head of navigation.

An advertisement was issued under date of October 15, 1890, calling for bids for the proposed work.

An abstract of the proposals received will be found in the annexed table.

On December 5, 1890, a contract was entered into with Mr. Augustus R. Wright to dredge 24,000 cubic yards, at 37½ cents per yard. Operations under this contract were commenced in April, 1891, and at the close of the fiscal year 18,389 cubic yards had been removed and 5,000 feet of the 40-foot wide channel had been completed.

The amount required to complete the improvement is $30,000, all of which could be expended during the fiscal year ending June 30, 1893.

Weymouth River, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry. The nearest lighthouse is on Long Island, Boston Harbor, Massachusetts. Commercial statistics are included in Boston Harbor, Massachusetts.

Money statement.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		4,468.46
July 1, 1891, balance unexpended		5,531.54
July 1, 1891, outstanding liabilities	$3,110.81	
July 1, 1891, amount covered by uncompleted contracts	2,104.13	
		5,214.94
July 1, 1891, balance available		316.60
Amount (estimated) required for completion of existing project		30,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		30,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Weymouth River, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard measured in scows.	Price bid for removal of bowlders over 6 tons each.	Remarks.
1	Augustus R. Wright, Portland, Me	$0.37½	$9.00	Lowest bid.
2	Metropolitian Dredging Company, Lynn, Mass	.66	10.25	
3	Bay State Dredging Company, Boston, Mass	.55	10.00	
4	Boynton Bro's, Boston, Mass	.52	8.00	

Contract awarded to Augustus R. Wright, with the approval of the Chief of Engineers.

B 13.

IMPROVEMENT OF HARBOR AT HINGHAM, MASSACHUSETTS.

Hingham Harbor is situated in the southern part of Hingham, or Hull Basin, which comprises all that part of Boston Lower Harbor south of Nantasket Roads.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for year 1888, Part 1, page 456.

The harbor covers an area of 1 square mile, and has extensive mud flats, bare at low tide.

The mean rise or fall of the tide is 9.4 feet.

The channel leading to Hingham, south of Ragged and Sailors Islands, was before improvement very narrow and crooked, and obstructed by sunken rocks and shoals. Its least width was 30 feet and least depth 4 feet at mean low water.

The object of its improvement is to widen and deepen the natural

channel from deep water near the head of the harbor to the steamboat wharf, a distance of 2,500 feet.

The original project for improvement was submitted December 23, 1874.

It provided for an improved channel on the east side of Sailors Island, past the west side of Beacon to the Hingham Wharf, 100 feet wide and 8 feet deep at mean low water, at an estimated cost of $11,000.

This project was modified January 20, 1885, when it was proposed to deepen the improved channel to 10 feet at mean low water, and to remove a mid-channel ledge lying between Chandler and Ragged Islands, measuring 128 cubic yards, at an estimated cost of $18,700.

The total amount appropriated for this harbor to date is $26,000.

The total expenditures to June 30, 1890, were $20,994.99.

At that date the channel had been improved as proposed by the modified project of 1885, through the ledge at a point about 1,600 feet northeast of the steamboat wharf, where it was 100 feet wide, 10 feet deep at mean low water. The remainder of the improved channel was 100 feet wide, 8 feet deep.

The act of September 19, 1890, appropriated $5,000 for the continuation of this improvement. It was recommended that this sum be expended in completing the present approved project, with the exception of the removal of the ledge between Chandler and Ragged Islands. This recommendation was approved, and an advertisement was issued under date of October 15, 1890, calling for bids for the proposed work.

An abstract of the proposals received will be found in the annexed table.

On December 5, 1890, a contract was entered into with Mr. Augustus R. Wright to dredge 20,000 cubic yards, at 18 cents per yard.

Operations under this contract were commenced early in May, 1891, and it was satisfactorily completed June 11, 1891, by the removal of 20,400 yards.

The channel is now 100 feet wide, 10 feet deep, at mean low water.

To complete the improvement will require an appropriation of $3,000, all of which could be expended to advantage during the year ending June 30, 1893.

The benefit to be expected by the completion of this improvement is a more convenient and safe navigation of the channel leading to the town wharves.

Hingham Harbor is in the collection district of Boston, Mass.

The nearest light-house is the Narrows light on the main ship channel in Boston Harbor, distant about 5 miles.

Money statement.

July 1, 1890, balance unexpended	$5.01
Amount appropriated by act approved September 19, 1890	5,000.00
	5,005.01
June 30, 1891, amount expended during fiscal year	4,093.36
July 1, 1891, balance unexpended	911.65
Amount (estimated) required for completion of existing project	3,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	3,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Hingham Harbor, Massachusetts, opened November 21, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, as measured in scows.	Price bid for removal of bowlders weighing over 300 tons each.	Remarks.
1	Boynton Bros, Boston, Mass	$0.25	$6.00	
2	Augustus R. Wright, Portland, Me	.18	5.00	Lowest bid.
3	Bay State Dredging Company, Boston, Mass	.25	10.00	

Contract awarded to Augustus R. Wright, with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Tonnage of the harbor in—

	Tons.
1884	273,090
1889	569.070
1890	600,000

B 14.

IMPROVEMENT OF HARBOR AT SCITUATE, MASSACHUSETTS.

Scituate Harbor is on the west shore of Massachusetts Bay, 14 miles from either Boston or Plymouth light-house, and just southwest of the direct sailing course of all ocean-going vessels entering Boston Harbor.

Before improvement the harbor had a low-water area of 57 acres approximately, more than 6 acres of which had a depth of at least 3 feet at mean low water. It was entirely open to the action of east winds, and the entrance was obstructed by may sunken bowlders. The depth on the bar was about 2½ feet at mean low water. The mean rise or fall of the tide is 9.8 feet.

A plan of the harbor, showing the proposed improvement, was published in the Annual Report of the Chief of Engineers for 1881, Part I, page 522.

The object of the improvement is to create a harbor of refuge for vessels bound to Boston that are too far south of their course to clear the dangerous ledges near Minots light-house.

The project for the improvement adopted in 1881 is to build two rubblestone breakwaters converging toward each other from opposite banks, and to dredge an anchorage basin with channels connecting with the sea and the town wharves.

The north breakwater, from Cedar Point, is to be 800 feet long, and the south breakwater, from the point of the First Cliff, is to be 730 feet. Both breakwaters are to be 20 feet wide on top and 4 feet above mean high water, except at their outer ends, which are to be built 6 feet higher, to serve as sites for entrance beacons.

The anchorage basin to be 30 acres in area approximately. The entrance channel to be 2,700 feet in length and 300 feet average width. The estimated amount of dredging (including the entrance channel) was 500,000 cubic yards, to give a depth of 15 feet in the entrance chan-

nel; 12 to 15 feet between the breakwaters; 12 feet immediately in rear of the south breakwater, and 10 feet for the anchorage basin at mean low water. The estimated cost of the breakwaters was $100,000 and of the dredging $190,000, a total of $290,000.

The total amount appropriated for this work to date is $62,500. The amount expended to June 30, 1890, was $51,670.20. The condition of the improvement on June 30, 1890, was as follows:

The north breakwater was 720 feet long, of full width and height; the entrance channel was 100 feet wide, 1,600 feet long, and 5 feet deep at mean low water. Nothing had been done on the south breakwater.

A portion of the beach between Cedar Point and the mainland was protected by a brush and stone bulkhead 450 feet long, in front of which was a stone apron 10 feet wide, 385 feet long. All known bowlders obstructing the entrance of the harbor were removed.

The channel leading from the anchorage basin to the town wharves was 25 feet wide, 1 foot deep at mean low water.

The river and harbor act of September 19, 1890, appropriated $10,000 for this improvement. A project for the expenditure of this amount was submitted October 1 and approved October 6, 1890. It was to widen and deepen the channel connecting the anchorage basin and the town wharves so that it should be 100 feet wide, 3 feet deep at mean low water.

An advertisement inviting bids for the proposed work was issued under date of October 15, 1890.

An abstract of the proposals received will be found in the annexed table.

On December 5, 1890, a contract was entered into with Mr. Augustus R. Wright to dredge 30,000 cubic yards, at 32½ cents per yard. This contract expires December 31, 1891. No operations were in progress under this contract during the fiscal year, and the condition of the improvement at the date of this report is essentially the same as on June 30, 1890.

The amount required to complete the improvement is $227,500. Of this amount $50,000 could be expended during the fiscal year ending June 30, 1893, in building the south breakwater.

Scituate is in the collection district of Plymouth, Mass. The nearest port of entry is Plymouth, Mass. The nearest light-house is Minot Light, about 5 miles distant.

The accompanying commercial statistics have been furnished by the collector of customs at Plymouth, Mass.

Money statement.

July 1, 1890, balance unexpended	$829.80
Amount appropriated by act approved September 19, 1890	10,000.00
	10,829.80
June 30, 1891, amount expended during fiscal year	68.50
July 1, 1891, balance unexpended	10,761.27
July 1, 1891, amount covered by uncompleted contracts	9,750.00
July 1, 1891, balance available	1,011.23
Amount (estimated) required for completion of existing project	227,500.03
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Scituate Harbor, Massachusetts, opened November 22, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard as measured in scows.	Price bid for removal of bowlders weighing over 3 tons.	Remarks.
1	Boynton Brothers, Boston, Mass	$0.34	$6.00	
2	Bay State Dredging Company, Boston, Mass	.41	5.00	
3	Metropolitan Dredging Company, Lynn, Mass	.40	6.00	
4	New England Dredging Company, Boston, Mass	.34	5.00	
5	Augustus R. Wright, Portland, Me	.32½	5.00	Lowest bid.

Contract awarded to Augustus R. Wright with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected 1890, none; 1891, none.

Shipping.	1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*
Entrances, domestic	18	2,800	38	3,800
Clearances, domestic	18	2,800	38	3,800

Imported.	1890.	1891.
	Tons.	*Tons.*
Coal	1,800	2,500
Lumber	1,600	4,000

The vessels frequenting the port draw not to exceed 9 feet.

B 15.

IMPROVEMENT OF PLYMOUTH HARBOR, MASSACHUSETTS.

Plymouth Harbor is situated 30 miles south of Boston. Its outer anchorage, the "Cow Yard," is common to Plymouth, Kingston, and Duxbury, and is the only refuge for seagoing vessels from northeasterly gales when caught between Boston and Provincetown, a distance of about 75 miles, following the coast line. The entrance to this outer anchorage is direct, unobstructed, and of ample width, and sufficiently deep for the wants of commerce. The anchorage is capacious and has good "holding ground," but the extensive tidal basins inside of it give rise to strong variable currents across it.

The inner or harbor proper is formed by Long Beach, a narrow, low sand spit 3 miles long, which runs generally parallel to the mainland and about a mile from it.

The harbor contains 2,000 acres, almost all of which is dry at low tide. A few narrow, crooked, shallow channels traverse these flats. These channels join about the center of the harbor, opposite the town wharves,

and form the main ship channel, 150 feet wide, approximately, and 10 feet deep at mean low water, which runs directly behind the northern half of Long Beach to the outer anchorage.

The maintenance of this inner harbor and channel depends on the preservation of Long Beach.

Before improvement about 6 inches depth of water could be carried to the town wharves at low tide.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 460.

Previous to 1875 the project was a general one and had for its object the *preservation* only of Long Beach. From the nature of the work it can at no time be considered completed, and small annual appropriations are necessary to repair any damages done by storms. The various devices employed for this purpose are described in the Annual Report of the Chief of Engineers for 1877, all of which have been remarkably successful.

The project for the *improvement* of the harbor was first adopted in 1885. It provided for dredging a channel from the town wharves to the main ship channel 2,286 feet long, 100 feet wide, and 6 feet deep at mean low water. This project was modified in 1877 so as to include the dredging of a basin 866 feet long, 150 feet wide, and 8 feet deep directly in front of the town wharves.

In 1884 and 1885 it was proposed to deepen the proposed channel and basin to 9 feet at mean low water, and to make the channel 150 feet wide.

The modified project of 1884 required the excavation of 81,000 cubic yards (scow measurement) and was originally estimated to cost $27,000.

This estimate was revised in 1885, in accordance with the low prices then current for dredging, and the cost was then estimated to be $22,500.

From 1866 to date the amount appropriated for this improvement was $128,000, of which there had been expended to June 30, 1890—

For beach protection	$76,915.48
Dredging	42,556.84
Total	119,472.32

The condition of the improvement on June 30, 1890, was as follows:

The improved channel was 115 feet wide, 9 feet deep at mean low water; the basin was 800 feet long, with an average width of 150 feet, 9 feet deep at mean low water.

The river and harbor act of September 19, 1890, appropriated for this improvement $8,000. This sum it was proposed to expend as follows: $1,500 to be reserved for probable necessary repairs to the works of preservation; $1,500 to be expended on necessary extensions and repairs of the works protecting Long Beach; and the balance, $5,000, to be expended in enlarging the basin to its full projected dimensions, and in enlarging the improved channel so that it would be 130 feet wide. This project was approved October 6, 1890.

An advertisement was issued under date of October 15, 1890, inviting bids for the proposed work.

An abstract of the proposals received will be found in the annexed table.

On December 6, 1890, a contract was entered into with the National Dredging Company to dredge 18,000 cubic yards, at 27 cents per yard. This contract expires December 31, 1891.

Operations under this contract were commenced during the latter part of June, 1891, and at the close of the fiscal year 6,918 cubic yards had been dredged. The condition of the improvement remains essentially the same as on June 30, 1890.

To complete the project will require an appropriation of $9,500, all of which could be expended during the fiscal year ending June 30, 1893.

A small sum should always be available for the harbor, to immediately repair any damage made by storms to Long Beach. These necessary repairs have in the last 20 years averaged $1,500.

The prospective benefits to commerce are increased facilities and safety in navigating the improved channel.

Plymouth Harbor is located in the collection district of Plymouth, Mass., of which Plymouth is the port of entry.

The nearest light-houses are the Plymouth (Gurnet) lights, about 5 miles from Plymouth, and Duxbury Pier Light, about 2 miles distant.

The accompanying commercial statistics for the fiscal year ending June 30, 1891, have been furnished by the collector of customs at Plymouth, Mass.

Money statement.

July 1, 1890, balance unexpended		$1,327.68
Amount appropriated by act approved September 19, 1890		8,000.00
June 30, 1891, amount expended during fiscal year		9,327.68
July 1, 1891, balance unexpended		156.29
July 1, 1891, outstanding liabilities		9,171.39
July 1, 1891, amount covered by uncompleted contracts	$1,867.86	
	2,992.14	
July 1, 1891, balance available		4,860.00
		4,311.39
Amount (estimated) required for completion of existing project		9,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		9,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Plymouth Harbor, Massachusetts, opened November 22, 1890, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidders.	Price bid for dredging per cubic yard, measured in scows.	Price bid for removal of bowlders weighing over 3 tons each.	Remarks.
1	Metropolitan Dredging Company, Lynn, Mass	$0.33	$6.00	
2	Augustus R. Wright, Portland, Me	.29½	5.00	
3	National Dredging Company, Wilmington, Del	.27	10.00	Lowest bid.

Contract awarded to the National Dredging Company with the approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected 1890, $108,174.31; 1891, $73,536.29.

Shipping.	1890.	
Entrances:	*No.*	*Tons.*
Foreign	2	1,864
Domestic	124	18,104
Clearances:		
Foreign	10	1,443
Domestic	120	17,148

Imported.	1890.	1891.
	Tons.	*Tons.*
Coal	23,500	18,065
Iron	1,325	1,973
Lumber	9,800	6,160
Miscellaneous	975	330

The vessels frequenting the port are coasting schooners drawing from 8 to 14 feet.

B 16.

IMPROVEMENT OF HARBOR AT WELLFLEET, MASSACHUSETTS.

Wellfleet Harbor is situated on Cape Cod Bay, 12 miles southeast of Provincetown Harbor.

A chart of the harbor was published in the Annual Report of the Chief of Engineers for the year 1888, Part I, page 478.

The harbor consists of an outer anchorage south of Smalley's Bar, and an inner harbor north of the same bar.

The outer anchorage is sufficiently capacious, free from obstructions, and protected to meet the present demands of commerce, but the inner harbor, although capacious and perfectly protected; has no low-water navigable connection with the town wharves.

It is 4,200 feet from the 6-foot contour to the wharves, and not to exceed 6 inches draft can be carried to them at mean low water.

The original project for the improvement of this harbor was submitted November 3, 1871. It was based on the survey provided for in the river and harbor act of January 31, 1871.

It proposed to dredge two channels, each 150 feet wide and 4 feet deep at mean low water; one 2,060 feet long, to reach "Central" and "Commercial" wharves, and one 1,400 feet long, to reach "Mercantile" wharf. It was also proposed to remove 204 cubic yards of sunken rocks. The cost of this project was estimated to be $30,000.

On November 28, 1887, a revised project was submitted. It was based on the survey provided for in the river and harbor act of August 5, 1886. It proposed to dredge a channel from the "Deep Hole" to the town wharves, 6 feet deep at mean low water, 100 feet wide, and 4,200 feet long, at an estimated cost of $24,000.

The total appropriations for this harbor to date have been $16,000.

By the river and harbor act of June 10, 1872	$5,000
By the river and harbor act of August 11, 1888	7,000
By the river and harbor act of September 19, 1890	4,000
Total	16,000

The total amount expended to June 30, 1890, was $11,339.79, and the condition of the improvement was as follows: "Mayo," "Bay," "Lobster," and "Lumpfish" rocks had been removed, and a channel had been dredged from the "Deep Hole" to the town wharves, 4,200 feet long, 4 feet deep at mean low water, and 25 feet wide. Opposite the town wharves the channel was enlarged to 75 feet wide, to facilitate the docking of vessels.

The act of September 19, 1890, appropriated $4,000 to continue this improvement. No appreciable benefit to commerce would result by the expenditure of this amount, and it is to be retained in the Treasury until additional funds are provided.

To complete the improvement will require an appropriation of $22,000, all of which could be expended to advantage during the fiscal year ending June 30, 1893.

The accompanying commercial statistics for the fiscal year ending June 30, 1891, have been furnished by the collector of customs at Barnstable, Mass.

Wellfleet is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry. The nearest light-house is Mayo Beach Light.

Money statement.

July 1, 1890, balance unexpended	$660.21
Amount appropriated by act approved September 19, 1890	4,000.00
	4,660.21
June 30, 1891, amount expended during fiscal year	10.58
July 1, 1891, balance unexpended	4,649.63
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893. Submitted in compliance with requirements of section 2 of river and harbor acts of 1866 and 1867.	22,000.00

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $253.35; 1891, $231.40.

Shipping.	1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*
Entrances:				
Foreign	.....	.....	.....	.....
Domestic	9	504	.....	.....
Clearances:				
Foreign	1	74	1	74
Domestic	.....	.....	.....	.....

Imported.	1890.	1891.
	Tons.	*Tons.*
Coal	1,250	1,250
Lumber	300	500
Miscellaneous	966	.....

Vessels from 8 to 11 feet draft frequent the port.

B 17.

IMPROVEMENT OF HARBOR AT PROVINCETOWN, MASSACHUSETTS.

Provincetown Harbor is situated at the extremity of Cape Cod, about 40 miles southeast from Boston Light.

It is one of the most valuable harbors of refuge on the Atlantic coast. The entire commerce of New England, and a very large local fishing interest, are directly benefited by its maintenance, which depends entirely on the preservation of the sandy beaches which inclose it.

Since 1826 the project has been a general one, and provides for the preservation of the harbor by building dikes, bulkheads, and sand-catches, and extensive planting of beach grass to repair or prevent storm damages to the beaches. From the nature of the work it can at no time be considered completed.

A full history of the improvements will be found in the Annual Reports of the Chief of Engineers for the years 1876, 1879, and 1886. A special dike across House Point Island Flats, to be built contingently, was recommended in the Annual Report for 1886. A plan of the harbor was published in the Annual Report of the Chief of Engineers for 1886.

The total appropriations or allotments for this work to date have been $153,978.44. The amount expended to June 30, 1890, was $143,063.66.

The condition of the improvement on that date was as follows:

LONG POINT.

This long, narrow, low point forms the southeastern limit of the harbor. Its northerly end was fully protected from easterly storm action; but the northwestern part of the point, opposite the fog-signal station, has for some time been abraded by storms, and to secure the light-house tract it will probably be necessary to extend the breakwater protecting the easterly shore 250 feet to the south and west.

The northwestern part of Long Point, between a point 2,000 feet west of Wood End Light and Abel Hill Dike, was narrow and low and needed additional protection.

ABEL HILL DIKE.

This dike was built to prevent the rush of water from Lancey's Harbor over House Point Island Flats into the main harbor.

The rapid wearing away of the southern sandspit that forms Lancey's Harbor had threatened to make a breach through the beach south of the dike. To guard against this, brush and wooden sand-catches had been built on the outer beach opposite the west end of the dike. They were all in good order.

HOUSE POINT ISLAND FLATS.

These flats remained essentially unaltered from the condition shown by the last survey, and, as stated in the Annual Report for 1887, it still appears unnecessary to commence the dike projected to be built across these flats. The most of the grass planted during the year 1888 had rooted and was growing at the date of this report.

BEACH POINT, HIGH HEAD DIKE, AND COVE SECTION.

These works were all in good order.

The river and harbor act of September 19, 1890, appropriated for this

improvement $7,500. Of this amount it was proposed to expend $6,000 in providing additional protection to Long Point at its weakest section west of Wood End Light. The necessary material was secured by inviting bids by circular letters, and it was delivered early in June, 1891. During the remainder of the month the work of construction was commenced with a force of hired labor. The bulkhead when completed will be 2,000 feet long, with groins connecting it with the grassed bluff in its rear.

At the close of the fiscal year the several works of preservation are in essentially the same condition as on June 30, 1890.

The nature of the works of preservation of the harbor requires a small sum to be always available for immediate repairs. Such necessary repairs have averaged $1,500 per annum.

The prospective benefit to commerce is the preservation of an important harbor of refuge.

Provincetown is a port of entry in the collection district of Barnstable, Mass. The nearest light-houses are Wood End and Long Point Lights.

The accompanying commercial statistics have been furnished by the deputy collector at the port of Provincetown, Mass.

Money statement.

July 1, 1890, balance unexpended	$3,414.78
Amount appropriated by act approved September 19, 1890	7,500.00
	10,914.78
June 30, 1891, amount expended during fiscal year	2,081.81
July 1, 1891, balance unexpended	8,832.97
July 1, 1891, outstanding liabilities	3.00
July 1, 1891, balance available	8,829.97
Amount (estimated) required for completion of existing project	1,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

Amount of revenue collected, 1890, $111.58; 1891, $1,932.75.

Shipping.	1890.		1891.	
	No.	*Tons.*	*No.*	*Tons.*
Entrances :				
Foreign	27	4,462	55	9,236
Domestic	.....	.....	16	2,000
Clearances :				
Foreign	20	1,924	27	5,500
Domestic	.....	.....	10	2,000

Imported.	1890.	1891.
	Tons.	*Tons.*
Coal	.....	5,000
Lumber	.....	2,000
Miscellaneous	1,000	9,300

Four thousand vessels of all sizes visited the port during the year, mostly for shelter.

B 18.

IMPROVEMENT OF HARBOR AT CHATHAM, MASSACHUSETTS.

Chatham Harbor is at the eastern end of Nantucket Sound, about 15 miles east of Hyannis, Massachusetts. Its outer anchorage, known as Chatham Roads, is a capacious, deep, unobstructed, harbor of refuge from northerly and easterly gales.

The inner harbor, locally known as "Stage" Harbor, is small, but well land-locked. It is about one-half mile long, 500 to 600 feet wide, and has 8 to 12 feet depth at mean low water. Its entrance is obstructed by three bars, on which the depth at mean low water is not to exceed 4 feet. The mean rise or fall of the tide is 5 feet.

The project for the improvement of the inner harbor was submitted December 19, 1890, and was based on a survey made in October, 1890. It proposed to dredge a channel 6 feet deep, at mean low water, through the three obstructing bars, 100 feet wide at the inner bar, 150 feet wide at the middle bar, and 200 feet wide at the outer bar, at an estimated cost of $10,000.

But one appropriation has been made for this improvement, viz:

By the act of September 19, 1890, $5,000.

This sum it is proposed to expend in dredging a channel 100 feet wide and 6 feet deep through the three bars.

Bids for this work were invited by public advertisement, dated January 10, 1891, and the proposals received were rejected as excessive.

No other operations were in progress during the year. The work will be again advertised during the summer months.

To complete the improvement will require an appropriation of $5,000, all of which could be expended to advantage during the fiscal year ending June 30, 1893.

Chatham Harbor is in the collection district of Barnstable, Mass., of which Barnstable is the port of entry; the nearest light-house is Harding Beach Light.

The accompanying commercial statistics have been furnished by the collector at Barnstable, Mass.

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	398.81
July 1, 1891, balance unexpended	4,601.19
Amount (estimated) required for completion of existing project	5,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging from Chatham Harbor, Massachusetts, opened February 10, 1891, by Lieut. Col. S. M. Mansfield, Corps of Engineers.

No.	Name and address of bidder.	Price bid for dredging per cubic yard, as measured in scows.	Price bid for removal of bowlders weighing over 3 tons each.	Remarks.
1	Eastern Dredging Company, Portland, Me	$0.44	$2.00	Lowest bid; informal.
2	Charles Cole, Fall River, Mass	.57	15.00	

Rejected with approval of the Chief of Engineers.

COMMERCIAL STATISTICS.

Amount of revenue collected, 1888, none; 1891, none.

Shipping.	1888.	1891.
Entrances—		
Foreign	None.	None.
Domestic		
Clearances—		
Foreign	None.	None.
Domestic		
Licenses granted, domestic	.....	16

Imported.	1888.	1891.
	Tons.	*Tons.*
Coal	2,000	3,000
Lumber	600	1,000
Miscellaneous	1,500	.....

Vessels drawing from 5 to 8 feet visit the port.

B 19.

PRELIMINARY EXAMINATION OF NORTH RIVER, SALEM, MASSACHUSETTS, FROM BEVERLY BRIDGE TO THE NORTH STREET BRIDGE.

[Printed in House Ex. Doc. No. 28, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated November 13, 1890, from Lieut. Col. S. M. Mansfield, Corps of Engineers, giving results of preliminary examination of North River, Salem, Mass., from Beverly Bridge to the North Street Bridge, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Mansfield reports that, with its limited present and prospective commerce, he is of the opinion that North River at this point is not worthy of improvement by the General Government. I concur in this opinion.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 13, 1890.

GENERAL: In compliance with instructions contained in letter from your office, dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of North River, Salem, Mass., from Beverly Bridge to the North Street Bridge, provided for in the river and harbor act approved September 19, 1890.

North River borders the city of Salem on the north and west, flows northeastwardly and enters Beverly Harbor lying just east of Beverly Street Bridge. It averages a quarter of a mile in width between the high-water lines, within the limits of this examination, and its low-water channel carries from 3 feet of water at the North Street Bridge to 6 feet water at the line of Marsh street, Salem, in a crooked course through about the middle of the flats.

In North Salem are two or three wharves near North Street Bridge, where there is annually delivered by light-draft vessels about 4,500 to 5,000 tons of coal, a dozen cargoes of wood and bark, and a half dozen cargoes of building materials. The east side of the river is now of no commercial importance and is almost entirely owned by the Eastern Division of the Boston and Maine Railroad, whose track skirts it.

The Naumkeag Street Railway Company have recently purchased a tract of land upon the western shore and propose to erect thereon an electric-power plant which will require delivered to it about 5,000 tons of coal annually.

Under chapter 194 of the acts of the general court of Massachusetts, in the year 1884, the city of Salem acquired possession of the flats in the river; section 1 of said act reads as follows:

> For the purpose of abating the nuisance in the city of Salem in that part of the North River lying easterly of North street, the said city may, from time to time, purchase or otherwise take any or all of the lands or flats in the said North River in Salem lying easterly of North street, and northerly of the location of the Eastern Railroad, and fill and raise the same to such grade as may be deemed necessary or expedient; or said city may dredge any flats taken by it under the authority of this act or heretofore taken by it under authority of chapter one hundred and eighty-five of the acts of the year eighteen hundred and eighty-three.

On three separate occasions within 10 years the city of Salem has dredged out the channel of the river at an expense altogether of $20,000; the last dredging was done about 2 years ago. I understand the river is again in need of dredging to remove the discomfort occasioned by the accumulation in it of filth from the town of Peabody, which empties its sewage into the river, and the refuse from a long line of tanneries, glue factories, and cotton-cleaning establishments discharged into the river above. Repeated dredging of this basin has become a necessity to remove the nuisance, and so long as it is permitted to use the river for this purpose, periodical dredging will be required in the interest of the health and comfort of the people of Salem.

Taking into consideration the present condition and use of the river, with its limited present and prospective commerce, I am of opinion that it is not worthy of improvement by the General Government.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

B 20.

PRELIMINARY EXAMINATION OF SHOALS AT THE MOUTH OF NORTH RIVER, MASSACHUSETTS, WITH A VIEW OF REMOVING THE SAME AND OTHER OBSTRUCTIONS.

[Printed in House Ex. Doc. No. 20, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated November 13, 1890, from Lieut. Col. S. M. Mansfield, Corps of Engineers, giving results of preliminary examination of "shoals at the mouth of North River, Massachusetts, with a view of removing the same and other obstructions," made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Mansfield reports that he is of opinion that the mouth of North River is not worthy of improvement, and I concur with him in this view.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL S. M. MANSFIELD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 13, 1890.

GENERAL: In compliance with instructions contained in letter from your office, dated September 20, 1890, I have the honor to submit the report of a preliminary examination of the shoals at the mouth of North River, with a view of removing the same and other obstructions, provided for in the river and harbor act approved September 19, 1890.

The North River is a very winding stream, about 15 miles long, flowing through extensive marshes between Hanover, South Scituate, and North Marshfield, Mass.

As it approaches the sea, as if to burst through the beach, it turns almost at right angles to the east and runs parallel with the seashore for about 4 miles before it finds its outlet, leaving a barrier against the sea about 20 rods in width, which at the time of my visit had all the appearance of being permanent, except for the half mile about its mouth, where it is narrower and devoid of any vegetation, and through which the river finds its outlet, varying in position according to the violence of storms and tides, its southern movement being limited by a rocky promontory just below the mouth of South River.

This barrier has on one or more occasions been breached by the waves during violent storms to the injury of the channel, which in connection with other circumstances has led to the total abandonment of all commercial enterprises upon the river, once famous for its shipbuilding.

The project of reclaiming the extensive marshes of the river has enlisted the consideration of no less distinguished persons than Professors Mitchell and Whiting, of the United States Coast Survey, and in their valuable reports the question of the practicability and economy of improving the inlet as a harbor, and the channel of the river so as to render it navigable, has been incidentally discussed.

Professor Whiting says:

> Owing to the limited extent and volume of the waters of North River its inlet is, and must ever be, of small capacity, and subject to change in width and depth by the action of storms upon the sandy bar and beaches at its mouth.
>
> The resultants of the natural forces at work upon the inlet and lower reaches of North River seem to determine towards a lessening of their depth and a shifting of the inlet southward. The results of Mr. Mitchell's survey show the capacity of the inlet and lower channel to be insufficient for the passage of a vessel suitable in size for the general purposes of freight or traffic. The inlet as a harbor of refuge is of no value.
>
> The excavation of a channel through the shoals of the lower reaches of the river would be attended with vast expense in proportion to the result obtained, and when done the whole work might be destroyed by the action of a single storm in breaking over the lower portion of the outside beach and sanding up again, and changing the whole physical condition of the outlet of the river.
>
> But should the artificial improvement of the mouth and channel of the river fully succeed, what would it effect?
>
> When shipbuilding and commerce occupied the borders of North River, no railroads or telegraphs controlled the business markets of the country, and the vessels built were of different style and different size from those of the present day. While it is true that a class of small vessels, such as coasting schooners, etc., might again be built upon the shores of North River, should its navigation be made sufficient for importing the necessary timber, and afterwards for launching the vessels and getting them out at sea, it is equally true that there are many harbors, rivers, and waters in Massachusetts, now unoccupied, which are more suitable for this business and purpose in their present natural state than North River would or could be after the greatest improvement practicable.
>
> Any large expenditure of money for the purpose of establishing maritime commerce only could scarcely be made to pay, and would probably never become of material value to the community settled upon the shores of this small river.

I coincide with these views, which are as sound to-day as when they were written, over 20 years ago. There does not appear to be any change from the conditions formerly existing unless it be, as predicted, a less depth of water upon the shoals at the mouth of the river, and the presence now just within its mouth of a mussel bank, forming a middle ground, or island, which is bare at low water and occupies nearly its whole bed.

The river at present is of no commercial value; its importance as a shipbuilding locality, which it had in earlier days, would not be revived even were the river improved, and but an insignificant commerce would be possible in this sparsely-settled region.

The cost of the improvement would be very great; even the removal of the mussel shoal just within the mouth of the river would probably exceed $25,000.

I am therefore of the opinion that the mouth of North River is not worthy of improvement.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

B 21.

PRELIMINARY EXAMINATION OF MYSTIC RIVER, MASSACHUSETTS, AND THE MALDEN RIVER, A TRIBUTARY OF THE MYSTIC, FROM THE BRIDGE OF THE BOSTON AND MAINE RAILROAD, EASTERN DIVISION, TO THE HEAD OF NAVIGATION ON SAID RIVERS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 1, 1890.

GENERAL: In compliance with instructions contained in letter from your office dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of the Mystic River, Massachusetts, and the Malden River, a tributary of the Mystic, from the bridge of the Boston and Maine Railroad, eastern division, to the head of navigation on said rivers, provided for in the river and harbor act, approved September 19, 1890.

These two rivers diverge just above the eastern railroad bridge, and their importance in relation to the preservation of Boston Harbor has been recognized by the Secretary of War in the establishment of harbor lines to the headwaters in each.

The main river (Mystic) extends westward a distance of about 2½ miles to the head of navigation in the town of Medford. The tributary (Malden) reaches to the northwestward, and is navigable for light-draft vessels to the second bridge in Malden, a distance of about 2 miles from its mouth, with a depth of barely 7 feet at high water.

Just above the confluence of these streams the Mystic is crossed by the bridge of the Boston and Maine Railroad, and about 2,000 feet higher by a highway bridge; both bridges have draws suitably located in the thread of the stream. The river is tortuous and near its head the difficulties of navigation are increased by shoal water, the river bed being bare at low tide for a distance of about 1,500 feet from the Medford Street Bridge. The coast survey of this river made in 1861 shows a navigable channel of 6 feet at mean low water to within about a half mile of Medford Bridge.

Shoaling has taken place since the date of this survey in the lower reach about the bridges and mouth of the Malden, which has interfered lately with navigation; some dredging in this locality to deepen the channel, and in the upper reaches to ease the sharp bends, will very materially aid in developing the commercial interests bordering the river, the business of which the past year is represented as—

25 lumber vessels	feet..	2,600.000
12 rum and molasses vessels	tons..	3,600
52 coal vessels	do...	19,000
55 stone vessels	do...	60,000

done by firms representing $600,000 invested capital, who say that they would double their business if the river was improved.

The land along the river is well suited to manufacturing purposes and all business needing water transportation, while the towns of Medford and Somerville would be furnished with valuable wharf sites and be benefited greatly by competition of water against rail transportation in their supply of coal and building materials.

I think the river worthy of improvement, and ask an allotment of $750 for a survey.

The river and harbor act of June 14, 1880, provided for an examination or survey of the Malden River, and the local officer (General Thom) submitted his report upon a survey of the river under date of Decem-

ber 1, 1880. He recommended the improvement of the river by increasing its width to 100 feet and its depth to 12 feet at mean high water from the mouth to the second bridge in Malden, at an estimated cost of $35,000.

This project was modified in 1882 to make the natural channel 100 feet wide and 12 feet deep to the first bridge, and thence 75 feet wide to the second bridge, at an estimated cost of $40,000.

Ten thousand dollars was appropriated toward this improvement in the river and harbor act of August 2, 1882, and with its expenditure the following season the channel was improved from the mouth to the drawbridge of Malden, a distance of 1¼ miles, to a least width of 50 feet, being 70 feet at turns, and a depth of 12 feet at mean high water. Additional funds were asked for by the local officer in his report for the year 1885 to complete the improvement, and again in 1886. The report for 1887 states the improved channel is in good order and meets all existing demands of commerce, and no appropriation is recommended.

The demands of commerce would now seem to warrant a continuation of this improvement. A dozen letters have been addressed to me on this subject from business men and manufacturers directly interested. The Malden Board of Trade and citizens generally are asking that the work of improving the river already begun shall be continued to completion. They say the present narrow and crooked channel, with only about 10 feet of water at mean high tide, and which should have not less than 15 feet, is not sufficient for the commerce of a city of 22,000 inhabitants; that the improvement of this river would be of great benefit not only to the city of Malden, but also to the surrounding towns. All heavy merchandise, such as coal, wood, lumber, bark, lime, cement, pipe, etc., a large part of which is now of necessity teamed from Boston, would then be shipped direct.

The following letter, signed by the president and committee of the Board of Trade of Malden will show the commercial importance of the river.

I consider the river worthy of improvement.

It is thought no new survey is necessary and that the funds recommended for this improvement in the Annual Report of the Chief of Engineers for the year 1886, viz, $37,000, will be sufficient to complete the approved project.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

LETTER FROM THE COMMITTEE OF THE MALDEN (MASSACHUSETTS), BOARD OF TRADE.

MALDEN, *October 24, 1890.*

SIR: The undersigned, a committee of the Malden Board of Trade, to which was referred the matter of Malden River improvement, beg leave to lay before you the following facts, viz:

The city of Malden has a population of 25,000, and during the last 5 years the average yearly increase has been nearly 2,500.

It has a taxable valuation of about $17,000,000, which represents property worth at least $20,000,000.

It has manufacturing interests on and near Malden River which are assessed at $1,216,000, and which doubtless have a much higher value, and the unoccupied land in the same locality is assessed at $147,300, which land would probably be used by

manufacturers, etc., were the proposed improvements made, and would be doubled or tripled in value.

We, of course, do not need to call your attention to the extensive and valuable property owned by the United States Government, located on this river and used as a niter depot but we beg to suggest that this adds force to our plea for this improvement.

During the year ending October 1, 1890, there were shipped to Malden for use in this city as follows, viz:

Coal	tons..	75,000
Wood	cords..	5,000
Bark	do...	5,000
Quartz	tons..	1,000
Lime and cement	barrels..	20,000
Last blocks		600,000
Lumber	feet..	50,000,000
Crude rubber, whiting, etc	tons..	7,500
Hides		70,000

and large quantities of stone, brick, and other building materials, hay, grain, and miscellaneous merchandise, which we are unable to specify.

During the said year 125 vessels arrived at Malden, although the tonnage was necessarily small, and it is beyond question that but for the condition of our river nearly all the shipments to Malden would be by water, the wharves being but a very short distance from the center of the city.

We respectfully submit for your consideration the accompanying communications bearing upon the subject-matter, and shall be pleased to give you any further information you may desire.

Yours, respectfully,

ALFRED E. COX,
JAMES W. GRAHAM,
JOHN E. STAPLES,
ELASON E. LOCKE,
JAS. H. WAITE,
Committee.
EVERETT I. STEVNS,
President.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

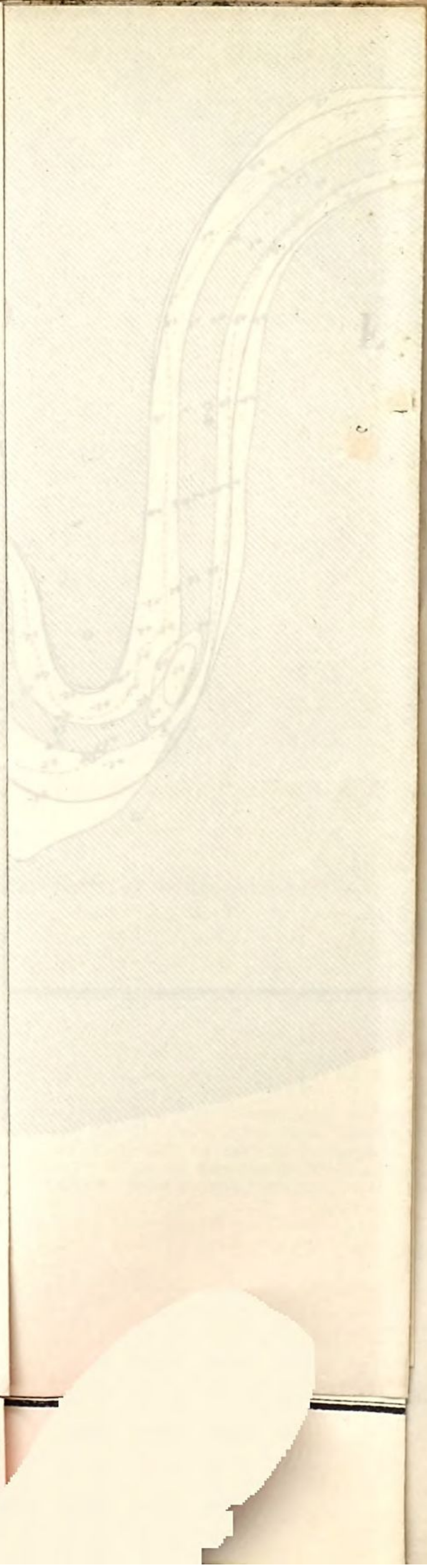
SURVEY OF MYSTIC RIVER, MASSACHUSETTS, FROM THE BRIDGE OF THE BOSTON AND MAINE RAILROAD, EASTERN DIVISION, TO THE HEAD OF NAVIGATION.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., May 9, 1891.

GENERAL: I have the honor to forward herewith a report of Mr. T. T. Hunter Harwood, assistant engineer, on the survey of Mystic River, Mass., from the bridge of the Boston and Maine Railroad (eastern division), to the head of navigation on said river, made in accordance with Department instructions of November 4, 1890, and to comply with the provisions of the river and harbor act of September 19, 1890. A tracing of the survey is also submitted.

The report of the preliminary examination is dated November 1, 1890, and I respectfully invite attention to it for a general description of the river, for its commercial importance, and the reasons for making the survey.

The improvement which I have the honor to recommend is to widen and deepen the natural channel of the river, so that it shall be 100 feet wide and 6 feet deep at mean low water, to the first turn above Dennings Wharf, and thence to the head of navigation, 4 feet deep with the width gradually reduced to 50 feet at Cradock Bridge.



The cost of this improvement is estimated as follows:

Dredging 80,000 cubic yards, at 28 cents	$22,400.00
Contingencies	2,600.00
Total	25,000.00

I respectfully invite attention to the report of Mr. Harwood for the details of the survey and a description of the river and its approaches.

Mystic River is in the collection district of Boston, Mass., of which Boston is the port of entry; the nearest light-house is on Long Island, Boston Harbor, Mass.

Very repectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. T. T. HUNTER HARWOOD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., April 3, 1891.

COLONEL: I have the honor to submit the following report upon the survey of "Mystic River, Massachusetts, from the bridge of the Boston and Maine Railroad (eastern division) to the head of navigation on said river," made in November, 1890, in accordance with your instructions, and therewith a map of the survey drawn to a scale of 1:3000.

TOPOGRAPHY.

A base line 2,400 feet in length was measured along the track of the Boston and Maine Railroad over the Mystic River Bridge, of the western division.

Thirty-two triangulation stations were located and occupied, all important angles being repeated at least three times. From these points a system of ranges was arranged on which the soundings were taken.

The high-water and low-water lines are from this survey.

The shore line shown is the approximate mean high-water line of the river banks in the marsh through which it flows, for the greater part of its length covered by the survey; large areas outside of these lines being overflowed by more than ordinary high tides.

HYDROGRAPHY.

The survey covers that section of the river extending from the Boston and Maine Railroad Bridge (eastern division) to the head of navigation, at a stone bridge known as Cradock Bridge, in the town of Medford, a distance of about 3½ miles. One hundred and forty-nine lines of soundings were run, at an average distance of 120 feet apart, on which 6,836 soundings were taken, 908 of which were intersected with a transit from favorable triangulation stations, and 66 taken on a marked line.

Two tide gauges were established from the bench mark at the United States navy-yard in Charlestown, by observations at high-water slack, one on the Boston and Maine Bridge, of the western division, the other at Dunning's coal wharf, about half way up the river.

The soundings are expressed in feet and tenths, and refer to the plane of mean low water at the navy-yard in Boston Harbor. They are selected from the number taken in the survey.

DESCRIPTION OF CHANNEL AS DEVELOPED BY THE SURVEY.

The Mystic River empties into Boston Harbor from the north, and extends from its mouth to the head of navigation, in the town of Medford, in a generally northwest direction. The distance from its mouth to the bridge of the Boston and Maine Railroad (eastern division), where the survey commences, is about 2½ miles, up to which point a clear 6-foot channel exists, passing two bridges known, respectively, as Chelsea

Bridge, with a draw opening of 44 feet 7 inches, and Malden Bridge, with a draw opening of 43 feet 4 inches.

Passing the draw of the Boston and Main (eastern division) Bridge, which is 44 feet in the clear, the channel extends northwest to the bridge of the Boston and Maine Railroad (western division), with a draw opening of 43 feet, and in this direction for about 1,000 feet beyond; thence it turns in a curve of about 700 feet radius, and runs west to about 400 feet from Middlesex Bridge, where the continuous 6-foot channel terminates. From this point the channel follows a tortuous course, with a greatest continuous depth of 2 feet, through the Middlesex Bridge, which has a draw opening of 53 feet, to within 1,500 feet of the head of navigation at Cradock Bridge, in the town of Medford. The total length of the channel covered by the survey, from the bridge of the Boston and Maine Railroad (eastern ivision) to Cradock Bridge, following the windings of the river, is 3½ miles; in a direct line the distance between the two bridges is 2½ miles.

BORINGS.

The character of the material composing the bed of the river is shown to be generally of a mixture of soft mud and sand. Twelve borings were made at different stations in the river, and the results are recorded in the table of borings annexed to this report and placed upon the map. The depths stated are below the same plane of reference to which the soundings were reduced.

Very respectfully, your obedient servant,

T. T. HUNTER HARWOOD,
Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

Table of borings in Mystic River.

No.	Sounding.	Material.	To a depth of—
			Feet.
1	2.8	Mud and sand	7.4
2	3.1	....do	6.5
3	2.7	....do	7.2
4	2.8	Mud, sand, and gravel	6.8
5	2.7	Mud and sand	7.8
6	2.7	....do	7.6
7	2.7	....do	7.7
8	2.8	Hard gravel and sand	6.5
9	2.4	Mud and sand	6.9
10	2.6	Sand and clay	8.1
11	3.0	Mud and sand	8.0
12	3.4	....do	8.5

B 22.

PRELIMINARY EXAMINATION OF ESSEX RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 13, 1890.

GENERAL: In compliance with instructions contained in letter from your office, dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of Essex River, Massachusetts, provided for in the river and harbor act approved September 19, 1890.

Essex River winds between marshy banks for 3½ miles from the head of navigation at the village of Essex, to its mouth, which forms a harbor of refuge for light-draft vessels on the Atlantic, about 3 miles to the southeastward of the entrance to Ipswich Harbor. The channel is very crooked and difficult to navigate by reason of sandbars and bowlders. These obstructions are said to be of a limited extent and easily removed,

and if accomplished would result in giving a high-water navigation of 2 feet greater depth than the present 7½ to 8 feet.

The commercial importance of this stream is almost entirely in its ship-yards, where it is said nineteen-twentieths of all the fishing vessels of Gloucester and Provincetown are built. At the time of my visit I saw 9 schooners on the stocks, of an average of 200 tons each. During this year 22 vessels, of an aggregate tonnage of 4,477 tons, have been built in the village of Essex, by 5 distinct firms, and this business has been carried on here for the past 50 years, rendering the river famous.

This industry should be encouraged to the fullest extent; the improvement of the river will add greatly to its prosperity, and as the cost of the work is believed to be light I am of opinion the river is worthy of improvement.

An allotment of $750 is recommended for a survey to enable me to make a plan and estimate therefor.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SURVEY OF ESSEX RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., May 15, 1891.

GENERAL: I have the honor to forward herewith a report of Mr. T. T. Hunter Harwood, assistant engineer, on the survey of Essex River, Massachusetts, made in accordance with Department instructions dated September 20, 1890, and to comply with the provisions of the river and harbor act of September 19, 1890. A tracing of the survey is also submitted.

The report of the preliminary examination is dated November 13, 1890, and I respectfully invite attention to it for a general description of the river, for its commercial importance, and the reasons for making the survey.

The survey shows that at least 4 feet depth can be carried in a sufficiently capacious channel, from the mouth of the river to a point about 12,000 feet from the head of navigation; and the improvement which I have the honor to recommend is to widen and deepen the natural channel of the river, so that 4 feet at mean low water can be carried to the head of navigation, in a channel 60 feet wide, and as indicated on the accompanying tracing.

The estimated cost of this improvement is as follows:

Dredging 70,000 cubic yards, at 30 cents	$21,000
Removal of bowlders, 109 cubic yards, at $10	1,090
Removal of ledge, 30 cubic yards, at $20	600
Contingencies	2,310
Total	25,000

I respectfully invite attention to the accompanying report of Mr. Harwood for the details of the survey and a general description of the river and its approaches.

Essex River, Massachusetts, is in the collection district of Gloucester,

Mass., of which Gloucester is the port of entry; the nearest light-house is Annisquam Light, 2 miles east of the mouth of the river.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. T. T. HUNTER HARWOOD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, May 1, 1891.

COLONEL: I have the honor to submit the following report upon the survey of Essex River, Massachusetts, made in December, 1890, in accordance with your instructions; and with it a map of the survey drawn to a scale of 1:3000.

TOPOGRAPHY.

Essex River empties into Ipswich Bay at a distance of about 2 miles southeast of the mouth of Ipswich River. An unobstructed 6-foot channel of ample navigable width is shown, by the U. S. Coast Survey map of 1857 and a survey of the lower part of the river made by the harbor and land commissioners of Massachusetts in the summer of 1890, to exist across the bar at its mouth and for a distance of 2½ miles up the river until past Conomo Point.

The distance between two of the main triangulation points of the harbor and land commissioners' survey was taken as the base line for this survey, and from this base (A-B, 5,569.29 feet in length) a system of triangles was extended up the river to the head of navigation. Eighteen triangulation stations were located and occupied, the more important angles being repeated at least three times. From some of these points a system of ranges was arranged on which soundings were taken for about half of the distance up the river, and for the remaining distance the soundings were taken on a marked line stretched from bank to bank from stakes located by angles from suitable triangulation stations.

The high-water line shown is the approximate line of the river banks in the marsh through which it flows. This marsh generally extends for some distance on either side of the river, and is overflowed by more than ordinarily high tides.

The only wharves are a small boat landing at Conomo Point and those shown at the extreme upper end of the river.

HYDROGRAPHY.

Soundings were taken to cover the main channel of the river from below Conomo Point to the head of navigation at the bridge of the Essex branch of the Boston and Maine Railroad. One hundred and forty-one lines were run, on which 7,341 soundings were taken.

The plane of reference is mean low water of the U. S. Coast Survey outside the bar, and was established by comparison of observations taken, on a temporary gauge, of normal high tides with predicted high waters given in the Coast Survey tide tables, the average rise of tides being given as 8.8 feet.

DESCRIPTION OF CHANNEL AS DEVELOPED BY SURVEY.

The approach to Essex River from Ipswich Bay is in a southerly course across the bar at its mouth. After passing the bar the channel runs in a southerly direction for about 1 mile. Here it turns to the west and continues westerly for about 1½ miles to where the continuous 6-foot channel ends, a short distance past Conomo Point. Beyond this the river follows a tortuous course in a generally southwesterly direction for about 2¾ miles to the head of navigation at the Boston and Maine Railroad Bridge.

The channel is narrow, crooked, and shoal, the greatest continuous depth being 1.7 feet, and is obstructed by nests of bowlders at points marked A, containing 30 cubic yards; B, containing 12 cubic yards; D, containing 62 cubic yards; and E,

Eng 91

containing 5 cubic yards; and by a ledge projecting from the north shore into the channel at C, of which a special survey is shown on the map.

At point marked F the remains of an old ford exists in the form of a bed of small bowlders about 15 feet wide, running across the channel. Examination of the bottom of the river shows the material to be mud and sand. At about 1,000 feet below the railroad bridge the river is crossed by a highway bridge with a draw opening of 24.5 feet. The ship-building yards, which comprise the main industry of Essex, are situated 2 just below and 1 above this bridge.

The bench-mark established is the south corner of a projecting stone at the northeast corner of the south pier of the drawbridge, and is 13.42 feet above mean low water.

Very respectfully, your obedient servant,

T. T. HUNTER HARWOOD,
Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

B 23.

[Printed in House Ex. Doc. No. 155, Fifty-first Congress, second session.]

PRELIMINARY EXAMINATION OF TOWN RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 1, 1890.

GENERAL: In compliance with instructions contained in letter from your office dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of Town River, Massachusetts, provided for in the river and harbor act approved September 19, 1890.

Town River is a small tidal river debouching into Weymouth Fore River, and lies entirely within the limits of the city of Quincy. It is about 1½ miles long from its mouth at Quincy Point to the upper wharves of the city, where lumber and granite are handled, and where large amounts of coal and heavy merchandise would be transferred were the facilities for navagating the river improved.

The upper half of the river (three-fourths of a mile) has a very narrow and crooked channel, carrying about 1½ feet of water at low tide, and this is the region demanding improvement to the extent of securing 4 feet of water through a channel 200 feet wide. With this accomplished, valuable wharf privileges will be given the city of Quincy in addition to those already established, for the channel will run near to one bank of the river.

During the past year about 300 cargoes of granite (30,000 to 40,000 tons) have been shipped, and over 40 cargoes of lumber landed, measuring 2,500,000 feet, and 3 cargoes of brick. About 35,000 tons of coal for Quincy were landed at the wharves at the mouth of the river (Quincy Point), a large portion of which would be delivered near the center of the city, and about 2 miles of teaming would be saved with an improved river.

I think the river worthy of improvement, and recommend an allotment of $450 for a survey upon which to base a plan and estimate for the work.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SURVEY OF TOWN RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE.
Boston, Mass., December 31, 1890.

GENERAL: I have the honor to forward herewith a report of Mr. Sophus Haagensen, assistant engineer, on the survey of Town River, Massachusetts, made in accordance with Department instructions of November 4, 1890, and to comply with the provisions of the river and harbor act of September 19, 1890.

A tracing of the survey is also submitted.*

The report of the preliminary examination is dated November 1, 1890, and I respectfully invite attention to it for a general description of the river, for its commercial importance, and the reasons for making the survey.

The survey shows that the natural channel of the river is sufficiently capacious to accommodate its present and prospective commerce to a point within 4,500 feet of the head of navigation.

From this point I respectfully recommend that the channel be improved by dredging so that it shall be 100 feet wide, 4 feet deep at mean low water, as indicated on the accompanying chart.

The cost of this improvement is estimated as follows:

Dredging 80,000 cubic yards, at 23 cents	$18,400
Contingencies	1,600
Total	20,000

I respectfully invite attention to the accompanying report of Mr. Sophus Haagensen, assistant engineer, for the details of the survey and a general description of the river and its approaches.

Town River, Massachusetts, is in the collection district of Boston, Mass., of which Boston is the port of entry; the nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. SOPHUS HAAGENSEN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., December 15, 1890.

COLONEL: I have the honor to report upon the survey of Town River, Quincy, Mass., made in November, 1890, in pursuance of your instructions; also to submit a map of the survey, drawn to a scale of 1:2,000.

TOPOGRAPHY.

A base line, A B, was measured from Ferry Point, Weymouth, westward 2,310.22 feet. From this base fourteen stations were located by triangulation on the plane-table, as well as shore lines, buildings, and objects used for ranges in the hydrographic work. The base line in the Weymouth (Fore) River survey of 1889 was connected with the present survey, and a part of the map of Weymouth River, below the junction with Town River, reproduced on the accompanying map. The shore lines, where not surveyed by us, have been taken from the U. S. Coast and Geodetic Survey maps, and are shown with broken lines.

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*Not reprinted.

HYDROGRAPHY.

The area covered by the survey extends from the junction of Weymouth (Fore) River with Town River, to the head of navigation at the wharves of the stone-yard in Quincy.

It contains about 240 acres within the shore lines, and of these about 112 acres were covered by our soundings.

One hundred and eight lines were run, aggregating in length 10 miles, upon which 2,000 soundings were taken. All the soundings were located by intersection from shore stations, except those in the river above Johnson's Wharf, which were run by time on lines between shore points.

The soundings are expressed in feet and tenths and refer to mean low water.

TIDES.

The tides are the same as for Boston lower harbor, viz:

	Feet.
Mean rise or fall of tide	9.4
Extreme low water observed	2.5
Extreme high water observed	12.2

A tide staff was set by the bench at Quincy Bridge (established in 1889), and from this another was established at Johnson's Wharf, by transferring the level of high-water slack.

A permanent bench was made at Johnson's Wharf, viz: A drill hole in the top of the corner coping-stone, said drill hole being 12.9 feet above mean low water, the plane of reference of the survey.

DESCRIPTION OF THE CHANNEL AS DEVELOPED BY THE SURVEY.

The first line of soundings on the map is 7 miles distant by water from the entrance to Boston Harbor, at Boston Light. Passing through Light-House Channel and Nantasket Roads, through Nantasket (or Hull) Gut, between Peddocks Island and Houghs Neck on the west, and Sheep Island, Grape Island, and Weymouth on the east, there is a continuous 18-foot channel. This ends at the southerly point of Germantown, where a bar runs across to Ferry Point; 14 feet can be carried across this bar to the junction of Weymouth and Town Rivers, where a middle ground, with only 4.8 feet over it, obstructs the channel. On the easterly and westerly sides of this middle ground are channels respectively 8 and 12 feet deep at mean low water. Up to a line drawn between Quincy Point and Sailor's Snug Harbor wharf, 12 feet can be carried; thence a bar 700 feet long (between the 12-foot contours) over which 9 feet can be carried; thence the "Deep Hole," a remarkable formation, 1,100 feet long by 600 feet wide, on the 12-foot contour; the hole is 48 feet deep at mean low water, and its sides are very steep; a series of similar "pot holes" are found on the shore (Hole Point).

Out of the "Deep Hole" a 6-foot channel, averaging 100 feet in width, leads for a length of 1,500 feet. Here the low-water channel is 300 feet wide, but splits up into three creeks through the mud flats, the southerly being the principal channel to the wharves in the city of Quincy. The latter is about 3,700 feet long, and varies in width from 100 to 200 feet, but is very crooked; throughout its length a 2-foot thread of water can be followed, meandering from side to side, but no regular 2-foot channel can be said to exist.

About 1,000 feet further west is the head of navigation; but the bottom of this part of the channel is above the plane of mean low water, and only 7 feet can be carried to the stone wharves in Quincy on an average high tide.

The total length of Town River Channel from its junction with Weymouth Fore River is thus 1.7 miles.

There are no bridges across this river.

BORINGS.

All the borings from the end of the 8-foot channel to the head of navigation show the bottom to be soft mud. The maximum and minimum depths to which the rod penetrated were, respectively, 13.7 feet and 7.1 feet at mean low water.

Very respectfully, your obedient servant,

SOPHUS HAAGENSEN,
Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

B 24.

[Printed in House Ex. Doc. No. 256, Fifty-first Congress, second session.]

PRELIMINARY EXAMINATION OF WEYMOUTH BACK RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 1, 1890.

GENERAL: In compliance with instructions contained in letter from your office dated September 20, 1890, I have the honor to submit the following report of a preliminary examination of Weymouth Back River, Massachusetts, in accordance with the river and harbor act approved September 19, 1890.

Weymouth Back River empties into Hingham Bay, Massachusetts, just eastward of Fore River, from which it is separated by Lower and Eastern Necks, and is narrow, crooked, and shallow, and of little commercial importance above the second bend.

Directly across its mouth lie Grape and Slate Islands, which are connected at low water, and forbid entrance from the northward. The channel to the eastward is very shoal and the main entrance is therefore through the western channel, which leads between Grape Island and Lower Neck, and has 3 fathoms of water; but it is so narrow that navigation for anything but a steamer is extremely difficult. Ten to 12 feet of water is found between the first and second bends, and 6 feet at mean low water can be carried to the bridge, 1½ miles from the mouth.

The mouth of the river is nearly 700 yards wide, mostly occupied by the large flats which make off from the eastern side of the entrance, extending northward nearly to Grape Island, and to the westward within 250 yards of Lower Neck.

The shoals extending southward from Grape Island, and northward from Lower Neck partly overlap, and render navigation here extremely difficult for vessels of a length commensurate with the depth of water that can be carried to the wharves of the Bradley Fertilizer Company's works, a third of a mile above.

These works are said to be the most extensive of their kind of any in the United States, and give employment to a large number of men. The past year over 500 vessels have been in and out of this river, handling about 100,000 tons of material, and the business is constantly increasing. This material comes from Europe, South America, the Southern and Northern United States, as well as the British Provinces, and manufactured goods are shipped by water to ports from Nova Scotia to New Orleans.

There being no railroad within 2 miles of this establishment, all the transportation is by water. Except on high water the river is not navigable for vessels drawing over 16 feet, and owing to the sharp turns and narrow channel the river is only open to vessels of medium length compared to their tonnage.

I consider the river worthy of improvement to the extent of straightening and widening the channel at the mouth and first bend, which will consist in dredging at a cost probably of $20,000, and I have the honor to recommend an allotment of $500 for a survey of this portion of the river upon which to base a project for its improvement.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SURVEY OF WEYMOUTH BACK RIVER, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., February 7, 1791.

GENERAL: I have the honor to forward herewith a report of Mr. Sophus Haagensen, Assistant Engineer, on the survey of Weymouth Back River, Massachusetts, made in accordance with Department instructions of November 4, 1890, and to comply with the provisions of the river and harbor act of September 19, 1890. A tracing of the survey is also submitted.*

The report of the preliminary examination is dated November 1, 1890, and I respectfully invite attention to it for a general description of the river, for its commercial importance, and the reasons for making the survey.

The survey shows that the channel of the river is obstructed by a narrow bar at its entrance, but is otherwise sufficiently direct and capacious to accommodate the present and prospective commerce, to a point within about 2,000 feet of the Fertilizer Company's wharf.

The improvement which I have the honor to recommend is to dredge a channel through the outer bar 200 feet wide and 12 feet deep at mean low water, and to widen and deepen the natural channel of the river to the same dimensions to the wharf of the Fertilizer Company, as indicated on the accompanying tracing.

The cost of this improvement is estimated as follows:

Dredging 79,000 cubic yards at 25 cents	$19,750
Contingencies	2,250
Total	22,000

I respectfully invite attention to the report of Mr. Haagensen for the details of the survey, and a description of the river and its approaches.

Weymouth Back River is in the collection district of Boston, Mass., of which Boston is the port of entry; the nearest light-house is on Long Island, Boston Harbor, Massachusetts.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. SOPHUS HAAGENSEN, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., January 28, 1891.

COLONEL: I have the honor to report upon the survey of Weymouth Back River, Weymouth, Mass., made in November, 1890, in pursuance of your instructions; also to submit a map of the survey, drawn to a scale of 1:3000.

TOPOGRAPHY.

A base line A–B, 1,022.32 feet long, was measured on the southerly side of the river opposite the Bradley Fertilizer Company's wharves. From this base six stations were located by triangulation, and the ranges for the hydrographic work were established from these points.

Parts of the shore lines near these stations were surveyed by us; the rest were taken from the United States Coast and Geodetic Survey maps.

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* Not reprinted.

HYDROGRAPHY.

The area covered by the survey extends from the entrance to the river between Grape Island and "Lower Neck," Weymouth, to the westerly end of Bradley Fertilizer Company's wharves, and is about one 1½ miles in length, measured along the axis of the channel. It contains about 323 acres within the shore lines, and of these about 180 acres were covered by our soundings. Fifty-six lines were run, aggregating in length 9 miles, upon which 1,825 soundings were taken. All the soundings were located by intersection from shore stations.

The soundings are expressed in feet and tenths and refer to mean low water. Those above and below the surveyed area (and expressed in feet and quarters) are from the U. S. Coast and Geodetic Survey manuscript map of 1867.

TIDES.

The tides are the same as for Boston Lower Harbor, viz:

	Feet.
Mean rise or fall of tide	9.4
Extreme low water observed	—2.5
Extreme high water observed	12.2

A tide-staff was set by the bench at Quincy Bridge (established in 1889), and from this another was established at Bradley's Wharf (as indicated on map), by transferring the level of high-water slack. The level of 10 feet above mean low water is marked by two spikes driven into the pile, to which the tide-staff was fastened.

DESCRIPTION OF THE CHANNEL AS DEVELOPED BY THE SURVEY.

The first (most westerly) line of our soundings on the map is 5¼ miles distant by water from the entrance to Boston Harbor at Boston Light. Passing through Light-House Channel and Nantasket Roads, through "Nantasket (or Hull) Gut," thence between Peddock Island and Hough Neck on the west, and Sheep Island and Grape Island on the east, there is a continuous 18-foot channel.

Having branched off from the channel leading to Weymouth Fore River and Town River, the Weymouth Back River channel turns to the east between Grape Island and Weymouth Lower Neck. The 18-foot channel, of a least width of 300 feet, is here interrupted by a bar 900 feet in length between the 18-foot contours. The line of greatest depression shows 11-foot soundings at its shoalest point; but this line is too sinuous to navigate. In the channel as marked by the buoys only 8 feet of water is available for a width of about 150 feet.

For a further distance of 1,400 feet there is still from 18 to 24⅓ feet soundings, while the 12-foot channel widens to 1,000 feet, thence for 2,300 feet the channel, of a least width of 250 feet, decreases in depth from 18 to 12 feet. From the end of the natural 12-foot channel to Bradley's Wharf, opposite which dredging has been done to 12 feet depth by the company, the distance is 1,150 feet on a straight line, but following the channel the distance is 1,800 feet. This abrupt curve is due to the spit which projects from the north shore and narrows up the 6-foot channel to a width of 150 feet near the red buoy. Above Bradley's Wharf the 6-foot channel is on the average 450 feet wide and has 12-foot holes in places.

On the part of the river surveyed by us there are no bridges. The first bridge is three-fourths of a mile above Bradley's Wharf and has a draw, 2 miles above which is the head of navigation.

BORINGS.

From random borings at the bar between Grape Island and Lower Neck, and at the spit near Bradley's Wharf, it is ascertained that the former consists mainly of coarse gravel and cobble stones; the latter is mostly coarse sand and gravel.

Very respectfully, your obedient servant,

SOPHUS HAAGENSEN,
Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

B 25.

PRELIMINARY EXAMINATION OF KINGSTON HARBOR, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., November 1, 1890.

GENERAL: In compliance with instructions contained in letter from your office dated September 20, 1890, I have the honor to submit the report of a preliminary examination of Kingston Harbor, Massachusetts, with a view to its improvement, provided for in the river and harbor act approved September 19, 1890.

Kingston Harbor is one of the three divisions which together constitute the inner harbor of Plymouth. To the northward is Duxbury Harbor; to the westward is Kingston Harbor, directly opposite the entrance from Plymouth Bay; and to the southward, Plymouth Harbor.

From the common anchorage near the entrance, called the "Cow Yard," channels of deep water diverge in several directions and lead to landings near the towns of Duxbury, Kingston, and Plymouth. These channels are circuitous indentations in the extensive flats of this basin, and afford the only means of communication between the towns and Plymouth Bay.

The channels to both Duxbury and Plymouth have been improved by the General Government to accommodate vessels of light draft.

Kingston is a small town situated about 1 mile inland on the Jones River, a small and crooked stream of little navigable importance. One small wharf at Rocky Nook is in Kingston Harbor proper, but just across the boundary line between Kingston and Plymouth Harbors, and about 2 miles from the center of Kingston, is located the extensive works of the Plymouth Cordage Company. Here the company have constructed and own the only wharf of any importance in the vicinity.

It is understood that the purpose of the applicants for the Government improvement of Kingston Harbor is to secure a deeper channel of approach to this wharf, which it is claimed will greatly benefit, not alone the cordage company, but the inhabitants of Kingston and North Plymouth, by enabling them to obtain supplies of coal and building materials at cheaper rates. They say in their petition:

> The locality has large and important manufacturing interests, employing about 800 persons from a population of 4,000 in the immediate neighborhood of the desired improvement. The materials used are principally imported by the proprietors from foreign ports, the duties on the same being paid on withdrawals from the bonded warehouses, of which there are four located on the premises of the factories. The supply of coal for the mills, as also the residents with lumber and other articles of domestic use, calls for the use of about fifty vessels each year, the masters of which are put to great inconvenience and delay, the channel being of insufficient depth to float them except at high course tides. The largest vessels have to lighten their cargoes at great expense.

The usual approach to this wharf is from the south through Goose Point Channel, which leads out of the channel to Plymouth near the head of Long Beach. For a distance of about three-fourths of a mile from the wharf the passage has not more than 1½ feet water at low tide.

The river and harbor act of 1884 provided for an examination of "Goose Point Channel in Plymouth Harbor to the wharf of the Cordage Company." The report of the engineer officer who made the examination will be found on page 538 of the Report of the Chief of Engineers for 1885. This officer discusses the proposed extension of Goose Point Channel, refers to a former communication, and says the project requires the excavation of 103,000 yards, and is estimated to cost about

$40,000, to permit vessels drawing 12 feet to work up through the channel at high water. He thinks that the channel would be permanent, and expresses the opinion that the proposed improvement is required only for the convenience of the Plymouth Cordage Company, and concludes that "the harbor is not worthy of improvement," as it does not promise sufficient benefit to commerce to justify the necessary expenditure by the United States.

The river and harbor act of 1888 provided for an examination of "Goose Point Channel, Plymouth Harbor, Massachusetts, to public wharf at Kingston."

The report of the officer who made this examination will be found on page 596 of the Report of the Chief of Engineers for 1889. He, likewise, does not think the extension of Goose Point Channel "worthy of improvement."

The scheme if executed will benefit one corporation only at an estimated cost of $40,000, and if extended to include other wharves and other interests, the estimated cost will not be less than $75,000, for which the General Government and the local interests would receive no adequate return.

The river and harbor act of 1890 provides for an examination of "Kingston Harbor, with a view to its improvement." The same object is here sought, viz: A deep-water channel to the wharf of the Plymouth Cordage Company. I have endeavored to learn to what extent the general public will be benefited by the improvement demanded, aside from that which will accrue to the cordage company.

Mr. G. F. Holmes, treasurer of the company, replies to my inquiries that owing to the extra rate of freight on account of being able to accommodate only the lightest draft vessels, the employés of the company have to pay an extra price for their coal.

In addition to this, our dock is used for the accommodation of parties who have no connection with our works, consequently any improvement in this part of the town would be for the benefit of the public and not for our exclusive good.

Mr. Philander Cobb, ex-collector of Plymouth, writes: "There is no place, in my opinion, where an appropriation could be more judiciously applied to benefit commerce than the improvement of the harbor of Kingston and of the approaches to the public wharves of said port and of North Plymouth; all of the wharves are as public as any in Plymouth or Boston."

I am satisfied that the wharf of the Plymouth Cordage Company is as public as any other, and that it is the wharf upon which the inhabitants of Kingston depend for transportation by water. It would appear that the benefits to follow an improvement of the channel leading to it will benefit the people of Kingston in affording better and cheaper facilities for transportation, while at the same time it will be a great benefit to the cordage company.

The petitioners for this improvement state that—

The duties paid by the manufacturers at North Plymouth and Kingston from July 1, 1886, to July 1, 1889, amount to $188,490.94. The records of the custom-house show that during the last 8 years 98 foreign vessels of the burden of 100 to 1,500 tons entered with cargoes for the locality your petitioners respectfully request to have improved.

A simple examination of Kingston Harbor is not sufficient to determine if it can be improved to meet the requirements, within a practicable outlay. There would seem to be sufficient in the above review to warrant my saying that the harbor is worthy of improvement, but a survey alone will enable me to determine if a channel adequate to the wants of the people can be made and maintained at reasonable cost

through the channel leading westward from the anchorage (Cow Yard), into Kingston Harbor.

An allotment of $1,000 is respectfully requested for this purpose.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Second indorsement.]

U. S. ENGINEER OFFICE,
Boston, Mass., November 6, 1890.

Respectfully returned to the Chief of Engineers, U. S. A.

In accordance with first indorsement hereon, I have the honor to state that in my opinion Kingston Harbor, Massachusetts, "is worthy of improvement."

S. M. MANSFIELD,
Lieut. Col. of Engineers.

SURVEY OF KINGSTON HARBOR, MASSACHUSETTS.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., May 25, 1891.

GENERAL: I have the honor to forward herewith a report of Mr. T. T. Hunter Harwood, assistant engineer, on the survey of Kingston Harbor, Massachusetts, made in accordance with Department instructions of November 7, 1890, and to comply with the provisions of the river and harbor act of September 19, 1890.

A tracing of the survey is also submitted.

The report of the preliminary examination is dated November 1, 1890, and I respectfully invite attention to it for a general description of the harbor, for its commercial importance, and the reasons for making the survey.

The survey shows that to improve the channel leading to Rocky Nook Wharf, Kingston, so as to obtain 6 feet depth at mean low water in a channel 100 feet wide, would cost $15,000.

A channel of these dimensions can be obtained leading to the Cordage Company Wharf in North Plymouth, the only one of any importance in the vicinity, at a cost of $10,000, as indicated on the accompanying tracing, and as stated in the preliminary examination such an improvement would benefit the town of Kingston.

The estimate of the cost of this improvement is as follows:

Dredging 30,000 cubic yards, at 30 cents	$9,000
Contingencies	1,000
Total	10,000

I respectfully invite attention to the accompanying report of Mr. Harwood for the details of the survey and a general description of the harbor.

Kingston is in the collection district of Plymouth, Mass., of which Plymouth is the port of entry; the nearest light-house is Duxbury Pier light.

Very respectfully, your obedient servant,

S. M. MANSFIELD,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. T. T. HUNTER HARWOOD, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., May 20, 1891.

COLONEL: I have the honor to submit the following report on the survey of Kingston Harbor, Massachusetts, made in November and December, 1890, in accordance with your instructions, and therewith a map of the survey drawn to a scale of 1:2000.

TOPOGRAPHY.

The distance between two triangulation points of the survey made in Plymouth Harbor in 1888 was taken as the base line of this survey. From this base, 10845.7 feet in length, a system of 9 triangulation stations was established along the shore. From these stations radiating ranges were laid out, on which soundings were taken.

The high-water and low-water lines shown are from this survey.

HYDROGRAPHY.

The area covered by the survey embraces the channels of approach to the wharf of the Plymouth Cordage Company in North Plymouth, and Rocky Nook Wharf in Kingston, west of the Miles or South Channel leading to Duxbury; 108 ranges, aggregating 29 miles in length, were sounded, on which 9,417 soundings were taken, 1,512 of which were located by intersections from suitable shore stations.

The bench mark is the sill of the canopy over Plymouth Rock in Plymouth, and is 17.24 feet above mean low water.

DESCRIPTION OF CHANNEL AS DEVELOPED BY SURVEY.

The Miles or South Channel to Duxbury starts from the west side of the common anchorage ground of Plymouth, Kingston, and Duxbury Harbors, known as the "Cow Yard," and extends westerly for about three-quarters of a mile, and then swings to the northwest toward Duxbury. At this bend the channel covered by the survey branches off, and continues in a west course for a further distance of 1 mile; then turning to the north it follows a tortuous course along the shore, at a distance of about one-half mile, to the mouth of Jones River in Kingston. This channel is 6 feet deep with a least width of 200 feet to east of Rocky Nook Wharf, where this survey ends.

From this channel, at about one-half mile west of its junction with the Miles Channel, a narrow shallow channel branches off to the south leading to the wharf of the Plymouth Cordage Company in North Plymouth. A narrow 6-foot thread of water winds through this channel to within 800 feet of the wharf. The greatest continuous depth to the wharf is 1.7 feet.

The channel leading to Rocky Nook Wharf branches from the main channel at its turn to the north, extends south about 800 feet, then, turning abruptly to the west, extends west 1,700 feet, where it turns north and follows along the shore to the wharf. The greatest continuous depth to this wharf is 1.5 feet.

The banks of the channels are generally sharply defined in the flats through which they flow, the material of which is sand and mud.

A comparison of these channels with those delineated on the U. S. Coast Survey manuscript map of 1870 proves them to be almost identical.

Very respectfully, your obedient servant,

T. T. HUNTER HARWOOD,
Assistant Engineer.

Lieut. Col. S. M. MANSFIELD,
Corps of Engineers, U. S. A.

B 26.

ESTABLISHMENT OF HARBOR LINES IN BOSTON HARBOR, MASSACHUSETTS.

a. HARBOR LINES FOR CHARLES RIVER, FROM MARKET STREET BRIDGE TO THE WATERTOWN DAM.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., January 23, 1891.

GENERAL: The Harbor Line Board for Boston Harbor, Massachusetts, constituted by Special Orders No. 38, Headquarters, Corps of Engineers, August 13, 1888, at sessions held in this city January 22 and



KINGSTON HARBOR,
MASS.

SURVEYED IN ACCORDANCE WITH
ACT OF CONGRESS OF SEPTEMBER 19, 1890.

SURVEY MADE UNDER THE DIRECTION OF
LIEUT. COL. S. M. MANSFIELD, CORPS OF ENGINEERS, U.S.A.
BY T. T. HUNTER HARWOOD, ASST. ENGR.

SCALE, 1:4000.

NOTE.
SOUNDINGS ARE EXPRESSED IN FEET AND TENTHS, AND REFER TO MEAN LOW WATER.
BENCHMARK IS RIM OF CANOPY OVER PLYMOUTH ROCK IN PLYMOUTH, AND IS 17.24 FEET ABOVE MEAN LOW WATER.

U. S. ENGINEER OFFICE, BOSTON, MASS., MAY 25, 1891.
RESPECTFULLY FORWARDED TO THE CHIEF OF ENGINEERS WITH REPORT OF THIS DATE.
LIEUT. COL. OF ENGINEERS.

TRUE MERIDIAN

ROCKY NOOK, WHF.

BILLINGTON'S LEDGE

NORTH PLYMOUTH

DUXBURY HARBOR

KINGSTON BAY

DUXBURY BEACH

GURNET

SAQUISH CHANNEL

KINGSTON HARBOR

Eng. 91

23, 1891, considered Charles River from Market Street Bridge to the Watertown Dam, and has the honor to submit for the approval of the Chief of Engineers and the Secretary of War certain harbor lines which are delineated upon the accompanying chart.*

On the south bank of the river the line starts at the termination of the line approved by the Secretary of War March 17, 1890, on the north side of Market Street Bridge, and follows the north side of said bridge, easterly, to a point 20 feet west of the east abutment of said bridge; and thence to the Watertown Dam, in a curved line which is indicated on the accompanying chart.

On the north side of the river the line starts at the termination of the line approved March 17, 1890, at the north corner of the west abutment of Market Street Bridge, and follows the face of the abutment to its south corner; and thence to the Watertown Dam in a curved line which is indicated on the accompanying chart.

The lines thus described are pier and bulkhead lines, beyond which no structure shall hereafter be permitted.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen.
G. L. GILLESPIE,
Lieut. Colonel of Engineers.
S. M. MANSFIELD,
Lieut. Colonel of Engineers.
W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 28, 1891.

Respectfully submitted to the Secretary of War.

The Harbor Line Board for Boston Harbor, Massachusetts, constituted by Special Orders No. 38, Headquarters Corps of Engineers August 13, 1888, submits for the approval of the Secretary of War harbor lines for Charles River from Market Street Bridge to the Watertown Dam, as delineated on the accompanying chart.

It is recommended that the lines selected be approved, and that the Secretary place his approval both upon the report and upon the accompanying map.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *January 29, 1891.*

Respectfully returned to the Chief of Engineers.

The harbor lines indicated herein and delineated on the accompanying tracing are approved.

L. A. GRANT,
Assistant Secretary of War.

---

*Omitted.

b. HARBOR LINES FOR NORTH SIDE OF THE "RESERVED CHANNEL," NORTH SIDE OF SOUTH BOSTON FLATS, AND AROUND CASTLE ISLAND.

UNITED STATES ENGINEER OFFICE,
Boston, Mass., January 23, 1891.

GENERAL: The Harbor Line Board for Boston Harbor, Massachusetts, constituted by Special Orders No. 38, Headquarters Corps of Engineers, August 13, 1888, at sessions held in this city January 22 and 23, 1891, considered the harbor lines about South Boston Flats not already established; along the north side of the "Reserved Channel;" the north side of South Boston Flats, and around Castle Island, and have the honor to submit for the approval of the Chief of Engineers and the Secretary of War the following-described lines which are delineated upon the accompanying chart,* Harbor Line Board Sheet O:

Beginning at the point of intersection of the easterly line of E street, in South Boston, with the southerly line of the Reserved Channel approved by the Secretary of War July 27, 1889, the bulkhead line follows said line of said street in a northerly direction 425 feet; thence runs northeasterly 323 feet to an intersection with a line parallel to and distant 700 feet from the southerly line of the Reserved Channel; thence along said parallel line to a point where it intersects a line drawn parallel to and 600 feet inside of the pier and bulkhead line on the north side of South Boston Flats, approved by the Secretary of War July 27, 1889, extended easterly towards Castle Island; thence northerly in a line normal to the curved portion of the exterior line of occupation of South Boston Flats to their intersection; thence westerly along said exterior line of occupation to a junction with the pier and bulkhead line before described and approved by the Secretary of War at its termination at or near Slate Ledge.

The pierhead line on the north side of the Reserved Channel begins at a point in the easterly line of E street in South Boston, 400 feet northerly of the point of intersection of said street line with the southerly side of the Reserved Channel, and runs easterly by a straight line and a short curve of 200 feet radius to a point 300 feet distant and south of the bulkhead line above described, and continues parallel to said bulkhead line and 300 feet distant therefrom till it intersects the exterior line of occupation of South Boston Flats; thence westerly along said latter line to a junction with the bulkhead line.

PIER AND BULKHEAD LINE AROUND CASTLE ISLAND.

Beginning at a point in the line of the south side of the Reserved Channel approved by the Secretary of War July 27, 1889, prolonged easterly and 2,550 feet from the westerly line of Q street, South Boston, the line continues easterly to the northwest corner of the north wharf on Castle Island; thence 60 feet following the outer face of said wharf; thence, southeasterly 770 feet; thence southerly 830 feet; thence westerly 575 feet; thence southwesterly 900 feet; thence northwesterly 950 feet; thence northeasterly 500 feet; thence northwesterly 500 feet; thence westerly 200 feet; thence northerly 650 feet to the point of beginning, as delineated on the accompanying chart, Sheet O.

The term pierhead is applied to lines beyond which no pile structure shall extend, and the term bulkhead to lines beyond which no solid filling shall hereafter be permitted.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen.
G. L. GILLESPIE,
Lieut. Colonel of Engineers.
S. M. MANSFIELD,
Lieut. Colonel of Engineers.
W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

---

*Omitted.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 28, 1891.

Respectfully submitted to the Secretary of War.

The Harbor Line Board for Boston Harbor, Massachusetts, constituted by Special Orders No. 38, Headquarters Corps of Engineers, August 13, 1888, submits for the approval of the Secretary of War harbor lines along the north side of the Reserved Channel, the north side of South Boston Flats, and around Castle Island, as delineated on the accompanying chart.

It is recommended that the lines selected be approved, and that the Secretary place his approval both upon the report and upon the accompanying map.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT, *January 29, 1891.*

Respectfully returned to the Chief of Engineers.

The harbor lines indicated herein and delineated on the accompanying tracing are approved.

L. A. GRANT,
Assistant Secretary of War.

APPENDIX C.

IMPROVEMENT OF RIVERS AND HARBORS ON SOUTHERN COAST OF MASSACHUSETTS, AND IN RHODE ISLAND; AND OF STONINGTON HARBOR, CONNECTICUT.

REPORT OF MAJOR W. R. LIVERMORE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Harbor of Refuge at Hyannis, Massachusetts.
2. Harbor of refuge at Nantucket, Massachusetts.
3. Marthas Vineyard, inner harbor at Edgartown, Massachusetts.
4. Vineyard Haven Harbor, Massachusetts.
5. Wareham Harbor, Massachusetts.
6. New Bedford Harbor, Massachusetts.
7. Westport Harbor, Massachusetts.
8. Taunton River, Massachusetts.
9. Pawtucket River, Rhode Island.
10. Providence River and Narragansett Bay, Rhode Island.
11. Removal of Green Jacket Shoal, Providence River, Rhode Island.
12. Greenwich Bay, Rhode Island.
13. Cove and water-way near Coaster Harbor Island, Rhode Island.
14. Newport Harbor, Rhode Island.
15. Harbor of refuge at Point Judith, Rhode Island.
16. Harbor of refuge at Block Island, Rhode Island.
17. Pawcatuck River, Rhode Island and Connecticut.
18. Harbor of refuge at Stonington, Connecticut.
19. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS.

20. Narragansett Bay Channel, Rhode Island, between Starve Goat Island and the mainland, with a view of deepening the same.
21. Watch Hill Cove, Rhode Island, in Little Narragansett Bay.
22. Newport Harbor, Rhode Island, south of Goat Island, with a view to the removal of the spit at the south end of the island.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., July 10, 1891.

GENERAL: I have the honor to submit herewith annual reports for the year ending June 30, 1891, for river and harbor works in my charge.

This office has been assisted by Assistant Engineers Edward Parrish, John H. Rostock, and Walter C. Simmons.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

C 1.

HARBOR OF REFUGE AT HYANNIS, MASSACHUSETTS.

The harbor of Hyannis lies on the south shore of the peninsula of Cape Cod, about 15 miles to the westward of the heel of the cape, and is an important harbor of refuge.

The mean rise and fall of the tide is about $3\frac{3}{4}$ feet.

ORIGINAL CONDITION.

Before improvement it was an open roadstead, exposed to southerly storms.

PLANS OF IMPROVEMENT.

In the years 1827–1838 a breakwater of riprap granite, 1,170 feet long, was constructed, covering an anchorage of about 175 acres, the entrance to which had a depth of about $15\frac{1}{2}$ feet. In the years 1852–1882 extensive repairs were made in increasing the width of its base and the size of the stone forming its sides and top.

The depth of water immediately inside the breakwater being insufficient for many vessels that seek the harbor of refuge, the present project for the improvement of the harbor published in the Report of the Chief of Engineers for 1885, volume 1, pages 560 and 619–621, contemplates dredging the area protected by the breakwater to a depth of $15\frac{1}{2}$ feet at mean low water.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on this work up to June 30, 1890, was $141,441.58. The breakwater had been completed according to the original project and the subsequent plans for strengthening it, and the $15\frac{1}{2}$-foot anchorage area had been increased by about 7 acres.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year work was in progress with plant consisting of the dredge *Texas*, tug *General Warren*, and two scows, all belonging to the United States, and was continued till July 11. By act of September 19, 1890, Congress appropriated $8,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers.

In accordance with this project dredging was resumed in the $15\frac{1}{2}$-foot anchorage area back of the breakwater May 19, 1891, with the same plant, except that the tug *Sargon* was substituted for the *General Warren*. On June 1, 1891, the *Sargon* was needed on the stone works and was replaced by a hired tug. Twenty-two thousand one hundred cubic yards were excavated during the year, which added about 4 acres to the $15\frac{1}{2}$-foot anchorage area protected by the breakwater.

Mr. C. O. Abell was the local superintendent of the work.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the dredging to a depth of $15\frac{1}{2}$ feet in the area limited on the west by a line running due north from the western end of the breakwater, and

on the north by a line running parallel to the breakwater, and distant 1,500 feet from it, leaving a berm of 100 feet along its northern side.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for ($17,662) to the execution of the project above referred to, of deepening the anchorage area inside the breakwater.

Hyannis Harbor is in the Barnstable collection district, and Barnstable is the nearest port of entry. The amount of revenue collected at Barnstable in the last fiscal year was $2,757.48.

The main value of the harbor is for a harbor of refuge. The nearest light-house is Hyannis Light; the nearest fortification is the fort at Clark's Point, New Bedford, Massachusetts.

Money statement.

July 1, 1890, balance unexpended	$3,521.95
Amount appropriated by act approved September 19, 1890	8,000.00
	11,521.95
June 30, 1891, amount expended during fiscal year	6,269.92
July 1, 1891, balance unexpended	5,252.03
July 1, 1891, outstanding liabilities	3,237.03
July 1, 1891, balance available	2,015.00
Amount (estimated) required for completion of existing project	17,662.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	17,662.00
Submited in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

[Furnished by Mr. A. F. Lothrop, Hyannis, Mass.]

Articles.	1888.	1889.	1890.
Imports:	*Tons.*	*Tons.*	*Tons.*
Coal	16,000	14,000	9,000
Grain	3,000	3,300	3,000
Lumber	1,951	1,625	6,000
Lime	38	38	300
Fish	100	100	300
Merchandise	100	.....	50
Exports:			
Merchandise, including fish, cedar posts, rails, etc	300	.....	.....

Vessels in harbor.

	1888.	1889.	1890.
Sailing	1,600	1,734	1,600
Steam	150	275	300

C 2.

HARBOR OF REFUGE AT NANTUCKET, MASSACHUSETTS.

Nantucket Harbor is the only one between the harbors of Marthas Vineyard (Vineyard Haven and Edgartown) and Provincetown, a distance of about 100 miles, except the small harbor of Hyannis, on the other (the north) side of Nantucket Sound. The navigation of this sound is intricate and dangerous by reason of numerous shoals. Nantucket Harbor has deep water inside, and the object of the improvement is to make it a harbor of refuge for vessels plying between ports north and south of Cape Cod, estimated to be 30,000 annually. In the memorial to Congress, on which the first appropriation for this harbor of refuge was based, it was stated that more than 500 vessels had been wrecked in the vicinity of the island.

The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the commencement of the present work there was a shoal about 1½ miles in width outside the entrance, through which shoal the channel or line of best water was only about 6 feet deep and very crooked and subject to changes in location.

PLAN OF THE WORKS.

The present approved project is to construct jetties of riprap stone projecting from either side of the present entrance to the harbor, for the purpose of concentrating the strength of the tidal currents and excavating a channel of 15 feet depth by scour, and at the places where the full depth required will not be reached by this means to complete the work by dredging. A plan of the works may be found in the Report of the Chief of Engineers for 1885, vol. 1, page 578.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on this project up to the close of the fiscal year ending June 30, 1890, was $144,951.30, and the result was the construction of the west jetty to a point 3,955 feet from the shore, and the east jetty to a distance of 834 feet from its initial point on shore, which is the outer end of the middle of the three northwest spurs built on Coatue Beach some years ago, and the foundation was laid and the jetty partially completed for an additional distance of 191 feet. The channel was deepened by scour to 7½ feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress.

By act of September 19, 1890, Congress appropriated $25,000 for the continuance of this improvement. A project for the expenditure of this sum, approved by the Chief of Engineers, contemplated continuing the construction of the east jetty, first with a partial cross-section and afterwards completing it to the full section if desired, and, if necessary, the raising of some low places in the west jetty; also, the deepening of the channel by dredging at such shoal spots as interfere to the greatest extent with navigation. In accordance with this project advertisements

for proposals for furnishing riprap granite were issued December 5, 1890, and the proposals opened January 5, 1891, and rejected. An abstract of the proposal received will be found in the appended table.

Preparations for doing the work by hired labor have been completed and the work is now progressing at the rate of about 300 tons per day. The first cargo was shipped June 26, 1891. A light has been maintained on the west jetty.

Mr. Charles W. Sherman is the local superintendent of the work.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the east and west jetties and the excavation by dredging of so much of the channel as may not be excavated by tidal scour.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

The work has been much delayed heretofore by the scour around the end of the jetty, making it necessary to build it in 15 feet of water instead of in 5. According to the present plan it is proposed to build up a considerable length of the jetty to the half-tide level before completing it to the full cross-section. The channel appears to be moving continually to the eastward and deepening slightly from year to year.

It is proposed to apply the balance on hand and the funds asked for ($100,000) to the further construction of the east jetty and raising low places in the west jetty, together with a little dredging if necessary.

Nantucket is in the Nantucket collection district and is a port of entry. There was no revenue collected in the last fiscal year. The value of the harbor is mainly as a harbor of refuge. The nearest light-houses are Nantucket Cliff and Brant Point lights. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1890, balance unexpended	$531.81
Amount appropriated by act approved September 19, 1890	25,000.00
	25,531.81
June 30, 1891, amount expended during fiscal year	8,303.59
July 1, 1891, balance unexpended	17,228.22
July 1, 1891, outstanding liabilities	2,613.22
July 1, 1891, balance available	14,615.00
Amount (estimated) required for completion of existing project	205,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and placing riprap granite in the east jetty at Nantucket, Mass., received at Engineer Office, Newport, R. I., in response to advertisement dated December 5, 1890, and opened at 12 o'clock noon, on Monday, the 5th day of January, 1891.

[Work to be commenced on or before May 15, 1891, and completed on or before December 31, 1891.]

No.	Name and address of bidder.	Price per ton of 2,000 lbs.
1	James Scully, Groton, Ct	$2.50

Rejected.

COMMERCIAL STATISTICS.

[Furnished by Mr. Joseph W. Clapp, collector of customs, Nantucket, Mass.]

Receipts by water.

Article.	1888.	1889.	1890.	Article.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
Coal	9,250	11,400	14,700	Lime	120	150	75
Grain	120	180	240	Cement	53	75	90
Flour	25	27	715	Wood	350	400	60
Hay	230	180	250	Salt	23	30	.....
Lumber	1,951	2,601	390	Railroad sleepers	120	125	.....
Brick	400	600	300	General merchandise	4,000	5,000	5,000

Vessels in harbor.

	1888.	1889.	1890.
Sailing	213	270	176
Steam	17	20	16
Yachts	.....	.....	11

C 3.

IMPROVEMENT OF MARTHAS VINEYARD, INNER HARBOR AT EDGARTOWN, MASSACHUSETTS.

The inner harbor at Edgartown lies in the northern part of the water way or strait that separates Chappaquiddick Island from the east end of Marthas Vineyard. It extends southward about 1½ miles from Chappaquiddick Point opposite Edgartown, and averages about one-fifth of a mile in width.

This harbor is so completely landlocked as to form a safe harbor of refuge for small vessels, but the contracted width of the entrance and the resulting velocity of the tidal currents makes it difficult to pass through.

This is a new work and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $2,000 for dredging in the harbor.

PLAN OF IMPROVEMENT.

It is proposed to excavate the middle ground to a depth of 10 feet at mean low water. This shoal lies in the central portion of the harbor.

A plat of the locality was published in House Ex. Doc. No. 59, Fifty-first Congress, first session.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work, a project for the expenditure of the available funds was prepared and was approved by the Chief of Engineers. This project provides for the commencement of dredging on the western side of the shoal, carrying the work as far to the eastward as the funds will permit.

Advertisements for proposals for doing this work by contract were issued November 21, 1890, but no bids were received.

Preparations have been made for carrying on the work by hired labor.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the middle ground to a depth of 10 feet at mean low water.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for, $2,500, to the completion of the project.

Edgartown is in the Edgartown collection district and is a port of entry. The amount of revenue collected there during the last fiscal year was $463.41; the nearest light-house is the Edgartown Light; the nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

Amount appropriated by act approved September 19, 1890	$2,000.00
July 30, 1891, amount expended during fiscal year	13.25
July 1, 1891, balance unexpended	1,986.75
July 1, 1891, outstanding liabilities	232.75
July 1, 1891, balance available	1,754.00
Amount (estimated) required for completion of existing project	2,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	2,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Mr. C. H. Merchant, collector of customs.]

Receipts and shipments for 1890.

	Tons.		Tons.
Receipts—		Shipments—	
Coal	2,172	Fresh fish	230
Iron	1,000	Quahaugs (in shells)	472
Grain	4,800	Clams (common)	135
Lumber	4,500	Sea clams	12
Flour	4,350	Scallop eyes	55
Hay	1,000	Molding sand	250
Brick	260	Coal furnished to steamers and vessels	125
Paving blocks	140	Ice furnished to steamers and vessels	500
Lime	35	Water furnished to steamers and vessels	800
Cement	30	Arrivals—	
Wood	105	Steamers	490
Telegraph poles	50	Sail vessels	625
Groceries, provisions, paints	2,500		
Miscellaneous	3,500		

Shipping for 1890.

No.	Vessels registered at Edgartown.	Tonnage. 1889.	Tonnage. 1890.
1	Steamer	1,272.51	1,821.99
1	Bark		
1	Brig		
1	Three-masted schooner		
17	Two-masted schooners		
19	Sloops, etc		

C 4.

IMPROVEMENT OF VINEYARD HAVEN HARBOR, MASSACHUSETTS.

Vineyard Haven is a deep indentation in the northern shore of the island of Marthas Vineyard, on the southern side of Vineyard Sound. It is triangular in form, and faces the northeast. The width of the mouth of the harbor, or the distance between the points of land on the east and west sides of the entrance known as East Chop and West Chop, is about $1\frac{1}{4}$ miles, and from a line connecting the chops to the narrow southerly end of the harbor, at which is situated the town of Vineyard Haven, the distance is about $1\frac{3}{4}$ miles. The entire area of the harbor between the shore lines is about 949 acres, of which some 657 acres have a depth of not less than 15 feet. The mean rise and fall of the tide is 1.7 feet.

At the mouth of the harbor the wearing away of the chops by the action of the waves in storms has been noted for many years. The former site of a light-house on West Chop has entirely disappeared. The débris is carried by the current into the harbor, where it forms shoals which are gradually impairing the anchorage capacity, especially in the upper part of the harbor.

PLAN OF IMPROVEMENT.

The plan of improvement contemplates the protection of the chops from the action of the storm waves, by the construction of jetties and other works along the shore.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on this project up to the close of the fiscal year ending June 30, 1890, including outstanding liabilities, was $23,339, and the result was, the temporary wharf at West Chop for the landing of material for the experimental jetties was partially built, and 1,093 tons of stone were placed in the jetties.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year work was in progress at the East Chop, and was suspended in July, 1890, and resumed in May, 1891.

By act of September 19, 1890, Congress appropriated $10,000 for the continuation of this improvement, and a project was prepared and approved by the Chief of Engineers. This project provides for constructing stone jetties on the East Chop, beginning at a point in front of the light-house and building the jetties at intervals of about 200 feet to the eastward; and constructing longitudinal walls on the West Chop, and such further work as experience shows to be advisable. In accordance with this project work was resumed by hired labor in May, 1891, and consisted in extending jetty No. 1 150 feet and building a longitudinal wall 80 feet long east of jetty No. 3, and the construction of a temporary railroad from the wharf to the site of the wall; 1,064 tons of stone from Mason Island quarry, which is operated by the Government, have been placed in the work. Mr. A. R. Elliot was the local superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is to continue the protection of the chops from the action of storm waves so far as may be necessary to prevent the sand from washing into the harbor.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for, $25,000, to continue the work of protection, mainly at the East Chop.

Vineyard Haven is in the Edgartown collection district. Edgartown is the nearest port of entry. The amount of revenue collected at Edgartown in the last fiscal year was $463.41. The nearest light-houses are those on East and West Chops. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1890, balance unexpended	$5,359.05
Received by Treasury settlement	2.74
Amount appropriated by act approved September 19, 1890	10,000.00
	15,361.79
June 30, 1891, amount expended during fiscal year	8,268.65
July 1, 1891, balance unexpended	7,093.14
July 1, 1891, outstanding liabilities	1,017.14
July 1, 1891, balance available	6,076.00
Amount (estimated) required for completion of existing project	25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	25,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS.

[Furnished by Mr. E. C. Lord, Vineyard Haven, Mass.]

Receipts.

Articles.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*
Coal	6,500	6,000	10,000
Grain	120	1,310	2,300
Lumber	1,300	1,000	2,000
Iron	.....	300	100
General merchandise	4,500	1,500	2,500

C 5.

IMPROVEMENT OF WAREHAM HARBOR, MASSACHUSETTS.

This harbor is an estuary at the head of Buzzards Bay. The object of the improvement is to deepen and widen the channel leading from Buzzards Bay to Wareham, the industries of which, and of several towns in the vicinity with which it is connected by rail, are chiefly the manufactures of iron, and depend largely on transportation by water of the material used therein. The commerce of Wareham is carried on in sailing vessels, and the channel is to be made a beating channel for such vessels.

Another object of the improvement is the raising of Long Beach, over which the sands from the bay were washed into the harbor. The mean rise and fall of the tide is 4 feet.

ORIGINAL CONDITION.

Before improvement the ruling depth in the harbor was about 7 feet at mean low water in a narrow and very crooked channel. Long Beach, a narrow sand spit at the mouth of the harbor, was washed and abraded by the waves and currents at high water, and the material was carried into and shoaled the channel inside.

PLANS OF IMPROVEMENT.

The original approved project of 1871 for the improvement, and its subsequent modifications, provide for a channel 250 feet wide and 10 feet deep at mean low water from Barney Point down to the entrance to the harbor. Above Barney Point the width of the channel is to be 350 feet, with the same depth, 10 feet, as below that point. The plan includes also the raising and strengthening of Long Beach, of which a large portion was submerged at low water, to carry it above the storm waves and currents and to hold it there, in order to prevent the filling of the improved channel above by material abraded from the beach.

A plat of Wareham Harbor, showing the lines of the channel now being excavated, may be found in the Annual Report of the Chief of Engineers for 1885, vol. 1, page 586.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The total amount expended on the improvement up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $83,968.63, and the result was that the channel in the upper part of the harbor had been completed, the approaches had been greatly widened, and their ruling depth increased from 7 to 9 feet; the channel for about one-half its width from Barney Point to Wareham and a portion of reach No. 9, formerly obstructed by the shoal known as the Middle Ground, had been dredged to 10 feet, and Long Beach had been raised to prevent the filling of the channel by sand.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress.

By act of September 19, 1890, Congress appropriated $5,000 for the continuation of this improvement. A project for the expenditure of this sum was prepared and approved by the Chief of Engineers. The project contemplates the completion of the eastern part of the channel to a width of 175 feet from the end of the present dredged channel to the deep water near Long Beach and the farther building up of Long Beach, and, if the funds remain, the widening of the upper reaches.

Advertisements for proposals for dredging were issued November 21, 1890, and the proposals opened December 22, 1890. An abstract of proposals received and the terms of the contract will be found in the appended table.

The time for commencing work under this contract has been extended to August 15, 1891.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the channel to its full width and depth down to the deep water above

Long Beach, and the further building up of Long Beach by the construction of sand fences.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance of the funds on hand and the appropriation asked for ($7,236) to the completion of the channel and to the further building up of Long Beach.

Wareham is in the New Bedford collection district. New Bedford is the nearest port of entry. The amount of revenue collected at New Bedford in the last fiscal year was $50,387.92. The nearest light-houses are Bird Island and Wing Neck lights. The nearest fortification is the fort at Clark Point, New Bedford, Mass.

Money statement.

July 1, 1890, balance unexpended	$145.39
Received by Treasury settlement	12.42
Amount appropriated by act approved September 19, 1890	5,000.00
	5,157.81
June 30, 1891, amount expended during fiscal year	903.88
July 1, 1891, balance unexpended	4,253.93
July 1, 1891, amount covered by uncompleted contracts	1,760.00
July 1, 1891, balance available	2,493.93
Amount (estimated) required for completion of existing project	7,236.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,236.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging at Wareham Harbor, Massachusetts, received at Engineer Office, U. S. A., Newport, Rhode Island, in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon on Monday, the 22d of December, 1890.

[Work to be commenced on or before March 15, 1891, unless otherwise agreed in writing between the contracting parties, and completed on or before December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	J. H. Fenner, Jersey City, N. J	20 cents.

Contract awarded to J. H. Fenner, of Jersey City, N. J., with the approval of the Chief of Engineers, and dated February 25, 1691.

COMMERCIAL STATISTICS.

[Furnished by Mr. Alden Besse, Wareham, Mass.]

Received and shipped, 1890.

	Tons.		*Tons.*
Coal	22,842	Lumber	176
Coke	2,880	Nails	7,704
Cranberries	2,128	Oyster shells	1,600
Flour	547	Sand	9,927
Grain	13,635	Sundry articles used in manufacture of iron and steel	2,160
Hoops and staves	800		
Iron	38,426		

C 6.

IMPROVEMENT OF NEW BEDFORD HARBOR, MASSACHUSETTS.

New Bedford Harbor is an estuary of Buzzard Bay and is the port of the cities of New Bedford and Fairhaven, Mass. New Bedford is an important port of entry. It is largely interested in manufactures, those of cotton predominating, and has an extensive commerce in addition to its whale fisheries. The population of New Bedford and Fairhaven in 1888 was about 38,000.

The object of the improvement is to provide a channel 18 feet deep at mean low water.

The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before improvement the channel had a ruling depth of about 12½ feet at mean low water.

PLANS OF IMPROVEMENT.

As early as 1839 some little dredging was done for the improvement of the harbor. The increase of depth obtained, however, was only 2 feet, and the cut but 30 feet wide. A survey of the harbor was made in 1852, but a definite project for its improvement was not made until 1874. The project provided for a channel 200 feet wide and 15 feet deep at mean low water from the deep water just above Palmer Island to the wharves at New Bedford. This project was modified in 1877, increasing the width of channel to 300 feet, and by means of appropriations made in 1875–'76, amounting to $20,000, the project was completed in 1877. Since that time vessels of larger draft have been employed in the harbor, and vessels of 15 feet draft not only now touch the bottom in this channel, but in the channel below Palmer Island, which was not included in the former improvement. There is not sufficient water for the commerce of the port.

The project under which work is now carried on was adopted in 1888. It provides for the excavation of a channel 200 feet wide and 18 feet deep at mean low water extending from Butler Flat to the vicinity of the wharves at New Bedford. A plat of the proposed improvement was published in House Ex. Doc. No. 86, Fiftieth Congress, first session.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended to June 30, 1890, including outstanding liabilities at that date was $29,966.02. The result was the excavation of the channel under the original project and its modifications to a width of 300 feet and a depth of 15 feet at mean low water, and the excavation of the western half of the 18-foot channel from the 11-foot bank to the deep water above Palmer Island, and thence the southern half of the channel to the vicinity of the wharves at New Bedford. The resulting increase in commerce renders a large anchorage area necessary for the accommodation of the large vessels which can now enter safely.

By act of September 19, 1890, Congress appropriated $10,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and approved by the Chief of Engineers. The project contemplates:—

(1) Dredging to a depth of 18 feet at mean low water so much of the point opposite buoy No. 11 as is included between the channel lines.

(2) Dredging to the same depth the eastern half of the proposed channel through the shoal between buoys No. 12 and 13.

(3) Dredging to the same depth a few points extending into the eastern half of the channel opposite Palmer Island.

(4) Dredging to the same depth the northern half of the channel from the deep water above Palmer Island to the vicinity of the wharves of New Bedford.

Advertisements for proposals for dredging were issued November 21, 1890, and the proposals opened December 22, 1890. All were rejected.

Some experimental digging has been done in the hard material forming the bottom of the channel, and the dredge *Texas* has been modified so as to adapt it to this work.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remaining half of the channel 200 feet wide and 18 feet deep, extending from the 11-foot bank to the vicinity of the wharves at New Bedford, and the removal of a few shoal spots between the 11-foot bank and Butler Flats, the southern end of the projected channel.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for ($15,000) to continuing the work of dredging in the new channel.

New Bedford Harbor is in the New Bedford collection district, which is a port of entry. The amount of revenue collected in the last fiscal year was $50,387.92.

The nearest light-houses are Clark Point Light and the lights in New Bedford Harbor. The nearest fortification is the fort at Clark Point, Mass.

Money statement.

July 1, 1890, balance unexpended	$57.53
Received by Treasury settlement	12.69
Amount appropriated by act approved September 19, 1890	10,000.00
	10,070.22
June 30, 1891, amount expended during fiscal year	3,038.55
July 1, 1891, balance unexpended	7,031.67
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	15,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging at New Bedford Harbor, Massachusetts, received at Engineer Office, U. S. A., Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d day of December, 1890.

[To be commenced on or before March 15, 1891, and completed on or before December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	E. Brainard, New York, N. Y	$0.16½
2	J. H. Fenner, Jersey City, N. J	.17
3	Henry DuBois' Sons, New York, N. Y	.19
4	Hartford Dredging Co., Hartford, Conn	.20

C 7.

IMPROVEMENT OF WESTPORT HARBOR, MASSACHUSETTS.

Westport Harbor is an estuary on the coast of Massachusetts, lying between Narragansett Bay, R. I., and Buzzard Bay, Mass. The site of the work is on Horse Neck Point (the north side of the entrance to the harbor).

ORIGINAL CONDITION.

Before the commencement of the improvement the site of the present work was a point of sand forming the northern and eastern boundary of the entrance to the harbor and subject to erosion by the sea and tides.

PLANS OF IMPROVEMENT.

The original approved project of 1887, with its subsequent modifications, provides for the construction of jetties at the end of Horse Neck Point, to stop the wearing of this point, the number and spacing of the jetties to depend on the cost of the work, and a small amount of dredging in Westport Harbor.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended to June 30, 1890, was $1,000, and the result was the construction of one jetty on Horse Neck Point.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $1,000 for the continuation of the improvement. A project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. This project provides for extending the present jetty to a point near the low-water line, and a small amount of dredging on the Lion Tongue Shoal, near the mouth of the west branch of the river.

Preparations have been made for carrying on the work by hired labor.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the extension of the present jetty and the dredging on the Lion Tongue Shoal.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for ($1,000) to the completion of the project above described.

Westport Harbor is in the collection district of New Bedford, which is a port of entry. The amount of revenue collected at New Bedford during the last fiscal year was $50,387.92. The nearest light-house is Seaconnet Light. The nearest fortification is fort at Clark Point, New Bedford, Mass.

Money statement.

Amount appropriated by act approved September 19, 1890	$1,000.00
June 30, 1891, amount expended during fiscal year	22.96
July 1, 1891, balance unexpended	977.04
Amount (estimated) required for completion of existing project	1,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	1,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

C 8.

IMPROVEMENT OF TAUNTON RIVER, MASSACHUSETTS.

This river rises in Norfolk County, Mass., and empties into Mount Hope Bay, a name given to the northeastern part of Narragansett Bay. It is about 44 miles in length, measured along its course.

The object of the improvement is to deepen and widen the channel leading to the city of Taunton, at the head of navigation, which requires large quantities of coal, iron, clay, moldings, sand, and other heavy articles for its extensive manufactures dependent largely on water transportation, so that vessels of 11-foot draft can reach the city at high water. The rise and fall of the tide before improvement was $5\frac{1}{4}$ feet at Dighton and 3.4 feet at Taunton.

ORIGINAL CONDITION.

In its original condition the channel was narrow and obstructed by bowlders, and from Berkley Bridge to Taunton the depth was not, in places, more than 5 feet at mean high water. A vessel of 30 tons burden was as large as could go up to Taunton.

PLANS OF IMPROVEMENT.

The approved project of 1871 and its subsequent modifications provide for a channel 60 feet wide and 11 feet deep from Weir Bridge to the ship-yard; a channel 80 feet wide (100 feet at the bends) and 11 feet deep from the ship-yard down to and through the Needles and Briggs Shoal; thence to Berkley Bridge a channel of the same width and 12 feet deep. From Berkley Bridge to the deep water at Dighton the channel was to be 100 feet wide and 12 feet deep. The depths are estimated from high water. The ledge which crossed the bottom of the river at Peter Point and the numerous bowlders which lay on the bottom and sides of the channel from Taunton to Dighton were to be removed.

A plat of the river showing the improved channel was published in the Annual Report of the Chief of Engineers for 1884, page 606.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on the improvement of the river up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $156,987.22.

With the exception that but 40 feet of the 60 feet of width could be dredged between the bridge at Weir and the ship-yard on account of interfering with private property, and that on account of the hardness and depth of material at the sides the 80-foot channel was not in all cases dredged to its full width, the channel down to Berkley Bridge had been completed. The channel as proposed between Berkley Bridge and Dighton had been completed, with the exception of removing a small amount of ledge rock uncovered in dredging, and had been cleared of bowlders from Taunton down to Berkley Bridge. The work of removal of the ledge at Peter Point had been completed. The material blasted in the channel had been dredged and deposited in the form of a half-tide dam running from Reuben Island to the west shore of the river, with the view of accelerating the current in the dredged channel off and above Dighton and preventing deposits in that part of the channel. Vessels of 11-foot draft can now reach Taunton at the head of navigation.

OPERATIONS DURING THE LAST FISCAL YEAR.

By act of September 19, 1890, Congress appropriated $7,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. This project contemplates dredging in that portion of the river just below Pioneer Rock, and extending the work up the river through Briggs Shoal and the Needles to the mouth of Three-Mile River, if funds permit.

Advertisements for proposals for dredging were issued November 21, 1890. The work was readvertised March 5, 1891, but no proposals were received in response to either advertisement.

Dredging was commenced June 18, 1891, with plant consisting of dredge *Rhode Island* and two scows belonging to the United States, and a hired tug.

The work was commenced at the first shoal above Berkley Bridge and continued upstream. The first reach and a portion of the second were completed.

Mr. Perry Lawton is the local superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There remain to complete the existing project the widening and deepening of the channel at a few points above the bridge and the removal of the small amount of ledge rock above referred to. This ledge projects about 30 feet into the eastern side of the channel, diminishing its depth by a few inches, while there is ample width and depth beyond the channel line on the western side.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for to the completion of the existing project for the improvement of the river.

Taunton River is in the Fall River collection district. Fall River is the nearest port of entry. The amount of revenue collected at Fall River in the last fiscal year was $71,080.32. The nearest light-house is the Borden Flat light-house. The nearest fortification is Fort Adams, Newport Harbor, Rhode Island.

Money statement.

July 1, 1890, balance unexpended	$27.78
Amount appropriated by act approved September 19, 1890	7,000.00
	7,027.78
June 30, 1891, amount expended during fiscal year	2,682.09
July 1, 1891, balance unexpended	4,345.69
July 1, 1891, outstanding liabilities	1,597.19
July 1, 1891, balance available	2,748.50
Amount (estimated) required for completion of existing project	7,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	7,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

COMMERCIAL STATISTICS.

[Furnished by Staples Coal Company, Taunton, Mass.]

Receipts.

Articles.	1888.	1889.	1890.	Articles.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
Lumber	16,250	16,250	17,062	Metals of all kinds	33,000	.....	35,000
Grain	39,774	39,600	41,760	Cotton	6,750	6,250	7,500
Flour	4,500	4,000	51,920	Molding sand	24,000	30,000	25,000
Coal	265,000	285,000	300,000	Clay	30,000	35,000	32,000
All other merchandise	30,000	35,000	32,000				

Number of vessels employed on Taunton River.

Year.	Sailing.	Barges.	Tugs.	Average draft.	Average tonnage.
				Feet.	
1889	46	9	4	10	500
1890	48	10	4	10	550
1891	48	10	4	10	500

C 9.

IMPROVEMENT OF PAWTUCKET RIVER, RHODE ISLAND.

The navigable part of the Pawtucket (or Seekonk) River, an arm of Providence River, extends from Providence to Pawtucket, a city which in 1885 had a population of about 23,000 and extensive manufactures, depending largely on water transportation. The object of the improvement is to widen and deepen the channel leading to Pawtucket, so that vessels of 12 feet draft can reach that city at mean low water. The mean rise and fall of the tide is about 5 feet.

ORIGINAL CONDITION.

Before improvement the channel in the river had a ruling depth of about 5 feet at mean low water.

PLANS OF IMPROVEMENT.

The original project, as modified in 1883, provides for the excavation by dredging of a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to the ledge opposite Grant & Co.'s Wharf at Pawtucket; thence the deepening by blasting of the channel through the ledge to Pawtucket Bridge to the same depth and 40 feet wide.

A plat of the river showing the lines of the proposed channel was published in the Annual Report of the Chief of Engineers for 1884, page 608.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The total amount expended up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $167,005.96. The channel had been excavated under the original project to a width of 75 feet and a ruling depth of 7 feet at mean low water, and under the project as modified in 1883 a new channel 12 feet deep and 100 feet wide, with wide enlargements at the bends, has been carried from its mouth at the deep water just above Red Bridge a distance of about 12,740 feet, and with a width of 60 feet and of the same depth for an additional distance of about 2,000 feet. There is now a channel 100 feet wide and 12 feet deep at mean low water from the deep water above Red Bridge to Bass Rock, or to within about 1¼ miles of the head of navigation, and a channel 60 feet wide and of the same depth from Bass Rock to a line about 200 feet above Dunnell's Wharf.

This completed portion of the channel is already a great benefit to the commerce of the river. A ruling depth of about 6 feet can be carried from the upper end of our present work to Pawtucket.

OPERATIONS DURING THE LAST FISCAL YEAR.

By act of September 19, 1890, Congress appropriated $30,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project contemplates continuing the excavation of the channel toward Pawtucket, affording at the same time such relief as the commerce may require at the shoalest places above the main work, and the commencement of work on the ledge in the channel off Pawtucket.

Advertisements for proposals for dredging were issued November 21, 1890, and the proposals opened December 22, 1890. All were rejected, and the work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. These were also rejected.

Abstracts of proposals received under both the above advertisements will be found in the appended table.

Preparations have been made for carrying on the work by hired labor. Two Government dredges and five scows will soon be ready for the work.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work yet to be done is to excavate the channel to its full width of 100 feet from Bass Rock to a point opposite Grant & Co.'s Whart, and thence to Pawtucket Bridge, to deepen the channel through the ledge to the same depth with a width of 40 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to extending the channel toward Pawtucket by dredging, and to commencing work on the ledge.

Pawtucket is in the collection district of Providence, and that port is the nearest port of entry. The amount of revenue collected at Providence in the last fiscal year was $328,849.56. The nearest light-house is Sassafras Point Light. The nearest fortifications are Fort Adams, Newport, R. I., and the fort on Dutch Island, Rhode Island.

Money statement.

July 1, 1890, balance unexpended	$656.05
Received by Treasury settlement	19.95
Amount appropriated by act approved September 19, 1890	30,000.00
	30,676.00
June 30, 1891, amount expended during fiscal year	12,128.02
July 1, 1891, balance unexpended	18,547.98
July 1, 1891, outstanding liabilities	307.48
July 1, 1891, balance available	18,240.50
Amount (estimated) required for completion of existing project	337,478.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Pawtucket River, Rhode Island, received at Engineer Office, U. S. Army, Newport, Rhode Island, in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d of December, 1890.

[To be commenced on or before March 15, 1891, and completed on or before December 31, 1891.

No.	Name and address of bidder.	Removing bowlders exceeding 1 cubic yard, per cubic yard.	Removing other bowlders and dredging, per cubic yard.
1	Elijah Brainard, New York, N. Y	$11.75	$0.33
2	Edgar M. Payn, Albany, N. Y	18.50	.37 3/10
3	Henry Du Bois Sons, New York, N. Y	20.00	.38
4	Geo. W. Townsend, Boston, Mass	9.00	.....

Received in response to advertisement dated March 5, 1891. Proposals opened at 12 o'clock, noon, Wednesday, March 25, 1891.

[To be commenced May 1 and finished December 31, 1891.]

1	Elijah Brainard, New York, N. Y	$11.75	$0.32 1/4
	Elijah Brainard, New York, N. Y	11.75	*.29 1/2
2	Edgar M. Payn, Albany, N. Y	15.00	.31

*If work is commenced September 1, 1891, and finished June 30, 1892.

COMMERCIAL STATISTICS.

[Furnished by Mr. Geo. E. Newell, Pawtucket, R. I.]

Receipts.

Articles.	1890.	1891.	Articles.	1890.	1891.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Coal	121,594	140,765	N. R. stone	116	253
Lumber	2,777	6,423	Spool wood	450	238
Pickets	31	.....	Iron	505	350
Laths	101	418	Fertilizer material	100	130
Shingles	39	95	Acid phosphate	175	.....
Bricks	3,838	54,405	Potash	150	130
Lime	591	540	Gravel	262	466
Cement	495	1,469	Cotton	51	127
Fire-clay	5	.....			

C 10.

IMPROVEMENT OF PROVIDENCE RIVER AND NARRAGANSETT BAY, RHODE ISLAND.

Providence River is an estuary of Narragansett Bay. The object of its improvement is to furnish a wide and deep channel for European and coastwise commerce from the ocean to Providence, a city which had in 1885 about 125,000 inhabitants, largely engaged in manufactures, and a port of entry for an extensive region of country, with which it is connected by railroads. The mean rise and fall of the tide is 4.7 feet.

ORIGINAL CONDITION.

Before the improvement of the river was commenced, in 1853, many shoals obstructed navigation, and at one point in the channel, a place called "The Crook," the available low-water depth was but 4½ feet.

PLANS OF IMPROVEMENT.

There was expended between 1852 and the 30th of June, 1882, $290,459.34 in deepening the channel; first to 9 feet, then to 12 feet, then to 14 feet, and again to 23 feet, as the increasing sizes of vessels and the growing commerce of Providence demanded. Bulkhead Rock was also removed during this period to a depth of 20 feet below mean low water.

The approved project of 1878, modified in 1882, under which we are now working, provides for a channel 25 feet deep and 300 feet wide, suitable for large ocean vessels, extending from Fox Point, in the city of Providence, to the deep water of Narragansett Bay, and for an anchorage basin between Fox and Fields Points of the following dimensions in cross sections, viz:

300 feet wide, 25 feet deep.
600 feet wide, 20 feet deep.
725 feet wide, 18 feet deep.
940 feet wide, 12 feet deep.
1,060 feet wide, 6 feet deep.

The 25-foot channel has been laid out in straight reaches (with enlargements at the angles) with a view to lighting them by range or leading lights, such as are used in similar cases in Chesapeake Bay, Delaware River, and other localities, if it should be found necessary.

A plat of Providence River, showing the improved channel, was published in the Annual Report of the Chief of Engineers for 1884, page 622.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on the present project up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $283,600.63. At that date the 25-foot channel, 300 feet wide, had been completed. Bulkhead Rock had been removed. The excavation of the 20-foot anchorage area has been completed in Fox Point Reach, and of the same areas in the Sassafras Point and the Fields Point reaches, about three-fourths and one-half respectively, had been finished.

The 18-foot area on the east side of Fox Point, and about three-fourths of the 18-foot area on the same side of Sassafras Point Reach had also been finished.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress.

By act of September 19, 1890, Congress appropriated $50,000 for continuing the improvement, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers.

The project contemplates, first, the completion of the entire anchorage area in the Fox Point Reach, and, second, the expenditure of the remaining funds towards the completion of the anchorage area in Sassafras Point Reach, beginning with the unfinished portion of the 20-foot area; and if funds remain, dredging in the 18, 12, and 6 foot areas, in the order named.

Advertisements for proposals for dredging under this project were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected and the work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. Abstracts of proposals received under both the above advertisements and the terms of the contract will be found in the appended tables.

Work under this contract was commenced April 29, 1891, and was in progress at the close of the fiscal year; 140,673 cubic yards had been excavated up to June 30, 1891, completing the 18, 12, and 6 foot areas on the west side of the Fox Point Reach.

Work was also commenced on the 12-foot area on the east side of the same reach.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

There is required for the completion of the existing project the remainder of the excavation of the anchorage basin between Fox and Field Points.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance of the funds on hand and the appropriation asked for to continuing the excavation of the anchorage area.

Providence River is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence in the last fiscal year was $328,849.56. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Money statement.

July 1, 1890, balance unexpended		$887.56
Amount appropriated by act approved September 19, 1890		50,000.00
		50,887.56
June 30, 1891, amount expended during fiscal year		24,678.39
July 1, 1891, balance unexpended		26,209.17
July 1, 1891, outstanding liabilities	$10,339.74	
July 1, 1891, amount covered by uncompleted contracts	10,739.43	
		21,139.17
July 1, 1891, balance available		5,070.00
Amount (estimated) required for completion of existing project		115,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		115,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Providence River and Green Jacket Shoal, Providence Harbor, Rhode Island, received at Engineer Office, U. S. A., Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d of December, 1890.

[To be commenced on or before March 15, 1891, and completed on or before December 31, 1891.]

No.	Name and address of bidder.	Price per cubic yard.
1	Henry Dubois's Sons, New York	$0.09½

Received in response to advertisement dated March 5, 1891, opened March 25, 1891.

[To be commenced March 15, 1891, and finished December 31, 1891.]

No.	Name and address of bidder.	Price per cubic yard.
1	Charles and Henry E. Du Bois, New York	$0.09
2	Atlantic Dredging Company, New York	.09 4/10

Contract awarded to C. and H. E. Du Bois, with approval of Chief of Engineers.

COMMERCIAL STATISTICS.

[Furnished by Providence Board of Trade.]

Foreign imports.

Articles.	1889.	1890.	Articles.	1889.	1890.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Lumber	3,632	9,252	Rubber	.....	152
Shingles	657	1,600	Ice	509	.....
Laths	1,407	1,737	Wool	3,815	10
Wood	1,166	.....	Starch	149	.....
Logwood	3,821	3,277	Lime	121	.....
Pickets	54	815	Potatoes	108	.....
Piling	812	953	Liquors	14	13
Brimstone	590	157	Tobacco	½	.....

By water and rail.

Articles.	1889.	1890.	Articles.	1889.	1890.
	Tons.	*Tons.*		*Tons.*	*Tons.*
Cotton	55.105	42, 298	Lumber	.....	112, 688
Wool	12, 388	.....	Flour	28, 668	29, 525
Coal	1, 054. 314	864, 925	Grain	44, 478	78, 227
Iron and steel	65, 876	62, 664	Dry goods	5, 266	.....
Oil	24, 003	21, 632	Print cloths	2, 616	2, 270
Waste	5, 811	2, 864	Chemicals	3, 343	.....
Beef	12, 486	10, 942	Liquors	9, 553	190

C 11.

REMOVAL OF GREEN JACKET SHOAL, PROVIDENCE RIVER, RHODE ISLAND.

Green Jacket Shoal is in that part of Providence River which constitutes the harbor of Providence.

It lies off the wharves on the south front of the city and occupies a part of the harbor that is required for anchorage purposes.

ORIGINAL CONDITION.

That part of the harbor in which the shoal is located is about 2,000 feet long by from 600 to 1,200 feet wide; and of this area the shoal, or rather that part of it which was included between the 15-foot curves, takes up about 18 acres. There were channels on either side of the shoal, between it and the harbor lines, having, the one on the north side, a width of 300 feet and, a depth of 20 feet, and the one on the south side, a width varying from 50 to 100 feet and a depth of about 15 feet at mean low water. The water on the summit of the shoal was 1 foot deep.

PLANS OF IMPROVEMENT.

The general project is the removal of the entire shoal to a depth of 25 feet at mean low water, limiting the work by lines drawn 200 feet from the harbor lines.

A plat of Green Jacket Shoal was published in the Annual Report of the Chief of Engineers for 1885, vol. I, page 599.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended, including outstanding liabilities, to June 30, 1890, was $54,250. The result was the excavation to a depth of 25 feet at mean low water of an area of about 13¾ acres, extending along the northern and western sides of the shoal, making an important addition to the anchorage facilities of the harbor. On a portion of this area the depth of water before the completion of the contract of November 18, 1886, was from 3 to 4 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $25,000 for continuing this work, and a project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project pro-

vides for the continuation of the dredging to the east and south of the area already excavated.

Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. These were all rejected.

The work was readvertised March 5, 1891. Proposals under this advertisement were opened March 25, 1891. An abstract of proposals received under both the above advertisements and the terms of the contract will be found in the tables appended to report on improvement of Providence River, Rhode Island, page 714.

The Government plant has been increased by the construction of large dump scows.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the remainder of the shoal to a depth of 25 feet.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for to continuing the removal of the shoal according to the general project.

Green Jacket Shoal is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $269,858. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are Fort Adams, R. I., and the fort on Dutch Island, Rhode Island.

For the commercial statistics, see Report of the Improvement of Providence River and Narragansett Bay, Rhode Island.

Money statement.

July 1, 1890, balance unexpended		$23.50
Received by Treasury settlement		10.07
Amount appropriated by act approved September 19, 1890		25,000.00
		25,033.57
June 30, 1891, amount expended during fiscal year		10,780.13
July 1, 1891, balance unexpended		14,253.44
July 1, 1891, outstanding liabilities	$332.44	
July 1, 1891, amount covered by uncompleted contracts	11,700.00	
		12,032.44
July 1, 1891, balance available		2,221.00
Amount (estimated) required for completion of existing project		33,096.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		33,096.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

C 12.

IMPROVEMENT OF GREENWICH BAY, RHODE ISLAND.

Greenwich Bay is an arm of Narragansett Bay, located in the towns of Warwick and East Greenwich, R. I. It has a length from northwest to southeast of about 3½ miles and an average width of 1½ miles.

The channel leading to the town of East Greenwich was deep enough

for the present demands of commerce, but so crooked as to render navigation difficult.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $2,000 for widening the channel.

PLAN OF IMPROVEMENT.

The improvement contemplated was the straightening and widening of the channel by the removal of sand bars and shoals.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work a project for the expenditure of the funds was prepared and was approved by the Chief of Engineers. The project provided for dredging to a depth of 10 feet at mean low water on the western edge of the bar extending out from Long Point, carrying the work to the eastward as far as the funds would permit. Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected. An abstract of the proposals received will be found in the appended table.

Work was commenced April 10, 1891, with the dredge *Texas*, tug *Sargon*, and scows, all belonging to the United States. The *Sargon* was required for other work and was transferred April 17, and replaced by a hired tug.

Nineteen thousand five hundred and ninety-two cubic yards were excavated during the year, and the result was the completion of the project, by cutting off the bar extending out from Long Point, about 210 feet. The channel was widened for a distance of about 500 feet.

Mr. C. O. Abell was the local superintendent.

The project being completed, no work is anticipated for the coming year.

Greenwich Bay is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $328,849.56. The nearest fortification is the fort on Dutch Island, Rhode Island. The nearest light-house is Warwick Light.

Money statement.

Amount appropriated by act approved September 19, 1890	$2,000.00
June 30, 1891, amount expended during fiscal year	1,896.08
July 1, 1891, balance unexpended	103.92
July 1, 1891, outstanding liabilities	92.92
July 1, 1891, balance available	11.00

Abstract of proposals for dredging at Greenwich Bay, Rhode Island, received at Engineer Office, Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon, on Monday, the 22d day of December, 1890.

[To be commenced on or before March 15, 1891, and completed by December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford, Conn	$0.18
2	Henry Du Bois Sons, New York, N. Y	.19
3	Chas. M. Cole, Fall River, Mass	.24½

COMMERCIAL STATISTICS.

[Furnished by Mr. Joseph Dews.]

Receipts for 1890.

	Tons.
Coal (about)	15,000
Lumber (about)	5,000

C 13.

IMPROVEMENT OF COVE AND WATER-WAY NEAR COASTER HARBOR ISLAND, RHODE ISLAND.

This cove is situated in the northwestern part of the city of Newport, R. I., near the southeastern extremity of Coaster Harbor Island, which is occupied by the U. S. Navy as a training station. A causeway connecting Coaster Harbor Island with Rhode Island forms the northern boundary of the cove and separates it from the water way above. This causeway having but one small opening has checked the flow of water around the island and caused deposits, so filling the water way as to cause it to give forth unhealthy and disagreeable odors.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $5,500 for improving the cove and water way.

PLANS OF IMPROVEMENT.

The projected improvement is to dredge the cove to the necessary depth, and to increase the flow of water by larger openings in the causeway, so that the garbage and waste thrown into the water will be carried away by the current.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work, a project for the expenditure of the available funds was prepared and was approved by the Chief of Engineers. The project contemplates deepening by 3 feet as much of the cove as the funds permit and making two additional openings in the causeway, spanned by two bridges.

Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. All were rejected. An abstract of proposals received will be found in the appended table.

Work was commenced February 6, 1891, with dredge *Texas*, tug *General Warren*, and scows belonging to the United States, and was suspended April 1, 1891, the *General Warren* having been replaced in the meantime by the tug *Sargon*, also Government property; 31,281 cubic yards were excavated, completing the dredging contemplated by the project.

The bridges are framed and ready to put in position in a short time.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

To complete the existing project it is only necessary to cut the causeway and erect the bridges.

Coaster Harbor Island is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $1,878.91. The nearest light-house is Gull Rock Light. The nearest fortification is Fort Adams, Newport, R. I.

Money statement.

Amount appropriated by act approved September 19, 1890	$5,500.00
June 30, 1891, amount expended during fiscal year	2,266.97
July 1, 1891, balance unexpended	3,233.03
July 1, 1891, outstanding liabilities	138.03
July 1, 1891, balance available	3,095.00

Abstract of proposals for dredging at Cove, Coaster Harbor Island, Rhode Island, received at Engineer Office, Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock, noon, on Monday, the 22d day of December, 1890.

[To be commenced on or before February 1, 1891, and completed by April 1, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford, Conn	$0.19
2	Henry Du Bois Sons, New York, N. Y	0.20
3	J. H. Fenner, Jersey City, N. J	0.21½
4	Charles M. Cole, Fall River, Mass	0.27½

C 14.

IMPROVEMENT OF NEWPORT HARBOR, RHODE ISLAND.

This harbor is at the main entrance to Narragansett Bay. These waters during the summer and winter constitute a harbor of refuge for our European and coastwise commerce quite equal in every respect to that of New York Harbor, and are even more accessible. The objects of the improvement are to widen and deepen the southern (the main) entrance to the harbor, and to enlarge its capacity for vessels seeking refuge in storms, by increasing the area and depth of the anchorage within it. The mean rise and fall of the tide is about 3¾ feet.

ORIGINAL CONDITION.

Before improvement the capacity of the inner harbor was limited by shoals, and it was not adequate to the number and size of vessels seeking it for refuge. The southern (the main) entrance was obstructed by a bar which stretched out from Goat Island, and the general business wharves of the city could not be reached at low tide by vessels drawing more than 8 feet.

PLANS OF IMPROVEMENT.

The original project and its modifications under which we are now working are substantially as follows:

Deepening the southern entrance to 15 feet at mean low water and widening it by dredging Goat Island Spit northward to a line drawn from the dolphin which marks the spit to clear the permanent dock at Fort Adams by 100 feet; the excavation of a channel 750 feet wide and 15 feet deep at mean low water around and to the eastward of this dolphin; excavating to 13 feet at mean low water the area included between the 13-foot curve on the west, a line drawn from the southwest corner of Perry Mill Wharf to Lime Rock on the south, the harbor line on the

east, and a line drawn parallel to and 50 feet from the city wharf on the north; excavating to 10 feet at mean low water the area northwest of a line drawn from Lime Rock through the spindle, which is in the southeast part of the harbor; the excavation of a channel 10 feet deep at mean low water along and outside the harbor line south to a point opposite the gas company's wharf, and the construction of jetties on the western shore of Goat Island to arrest the drift of littoral sand and gravel into the southern entrance.

A plat of Newport Harbor, showing the plans of the work, was published in the Annual Report of the Chief of Engineers for 1885, Vol. I, page 604.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended up to the close of the fiscal year ending June 30, 1890, including outstanding liabilities at that date, was $120,202.03, with the following results:

The area to be dredged to 13 feet within the harbor had been completed. The channel along and outside the harbor line south to a point opposite the gas company's wharf, and the 15-foot channel 750 feet wide around and to the eastward of the dolphin on Goat Island Spit, had been completed, with the exception of a strip along the western edge and to the north of the dolphin. The berth for vessels at the quartermaster's wharf at Fort Adams had been deepened to 10 feet at mean low water, and the littoral sand from the outside of Goat Island had been stopped for the present from washing into the channel at the southern entrance of the harbor by the construction of a jetty on the west side of the island. The southern entrance is completed for vessels of 15 feet draft, and of the total area to be dredged within the harbor (about 90 acres) about two-thirds had been completed.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1891, Congress appropriated $12,500 for continuing the improvement.

A project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. This project provides for the completion of the 15-foot channel by dredging the remainder of the strip along the western edge north of the dolphin; for dredging in the 10-foot anchorage area, and, if necessary, for the construction of an additional jetty on the west end of Goat Island. Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. An abstract of the proposals received and the terms of the contract will be found in the appended tables.

Work under this contract commenced February 7, 1891, and was finished April 18, 1891. Thirty-four thousand eight hundred and forty-six cubic yards were excavated in the areas specified by the project, and the result was the dredging of the strip along the western edge of the 15-foot channel north of the dolphin and the excavation of about 6 acres of the 10-foot anchorage area.

Mr. R. J. Easton was inspector of the work.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the excavation of the 10-foot anchorage area within the harbor and the building of

additional jetties outside of Goat Island whenever they may be required to arrest the drift of littoral sand and gravel into the harbor entrance.

OPERATIONS CONTEMPLATED DURING THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the funds asked for to the completion of the existing project.

Newport is in the collection district of Newport, and is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $1,878.91 The nearest light-houses are Lime Rock and Newport (Goat Island) lights. The nearest fortification is Fort Adams, Newport, R. I.

Money statement.

July 1, 1890, balance unexpended	$11.68
Received by Treasury settlement	5.09
Amount appropriated by act approved September 19, 1890	12,500.00
	12,516.77
June 30, 1891, amount expended during fiscal year	11,200.89
July 1, 1891, balance unexpended	1,315.88
July 1, 1891, outstanding liabilities	1,295.88
July 1, 1891, balance available	20.00
Amount (estimated) required for completion of existing project	27,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	27,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging at Newport Harbor, Rhode Island, received at Engineer Office, Newport, R. I., in response to advertisement dated November 21, 1890.

[To be commenced on or before March 15, 1891, and completed not later than December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford Conn	$0.20⅞
2	J. H. Fenner, Jersey City, N. J	.21½

Contract awarded to Hartford Dredging Company, with the approval of the Chief of Engineers, and dated January 22, 1891.

COMMERCIAL STATISTICS.

[Furnished by Mr. J. H. Cozzens, collector of customs.]

Receipts.

Articles.	1889.	1890.	1891.	Articles.	1889.	1890.	1891.
	Tons.	*Tons.*	*Tons.*		*Tons.*	*Tons.*	*Tons.*
Lumber	19,749	18,855	20,563	Drain pipe	.....	5,000	4,500
Shingles	704	950	997	Sand and gravel	.....	10,000	12,000
Laths	1,294	1,062	1,310	Flagstone	.....	1,000	1,000
Coal	50,000	50,000	50,000	Granite	.....	20,000	25,000
Lime	2,550	2,250	2,250	Iron	.....	2,000	2,000
Cement	1,950	1,650	1,650	Ashes	.....	41	49
Brick	18,000	18,800	18,000	Fish	.....	2,000	3,000
Hay	1,500	5,000	7,000	Potatoes	.....	1,800	3,000
Grain	1,200	1,800	1,500	Plaster	.....	375	500
Cordwood	.....	1,250	1,500	Hair	.....	200	200
Marble	.....	1,500	3,500				

Shipping.

Years.	Arrivals of vessels from foreign ports.		Vessels owned in Newport.	
	Number.	Value of cargoes.	Number.	Gross tonnage.
1889	29	$16,271.92	143	7,694.54
1890	19	17,398.59	148	7,972.93
1891	25	17,786.90	146	11,390.89

C 15.

HARBOR OF REFUGE AT POINT JUDITH, RHODE ISLAND.

Point Judith is the southeastern extremity of South Kingston, R. I., and marks the southwestern entrance to Narragansett Bay. Its shores are covered with bowlders, and a number of wrecks are scattered along the beach on each side of the point. A long ledge, known as Squid Ledge, extends for nearly a mile in a south by easterly direction about 1½ miles west of the point.

This is a new work, and no appropriation had been made for it until, by act of September 19, 1890, Congress appropriated $75,000 for a National Harbor of Refuge at Point Judith.

PLAN OF IMPROVEMENT.

It is proposed to construct breakwaters along the course of Squid Ledge, mentioned above, and between the southern extremity of the ledge and Point Judith.

A plat of the locality was published in House Ex. Doc. No. 66, Fifty-first Congress, first session.

OPERATIONS DURING THE LAST FISCAL YEAR.

Immediately after the passage of the act making the appropriation for this work, a project for the expenditure of the available funds was prepared and was approved by the Chief of Engineers. The project provides for commencing the work on the outer end of Squid Ledge, and extending the one arm to the north, and the other to the east, with a view to securing a sheltered area for the vessels engaged on the work.

Advertisements for proposals for furnishing and placing riprap granite were issued December 5, 1890, and proposals opened January 5, 1891. All were rejected. An abstract of bids received will be found in the appended tables.

The work was commenced February 13, 1891, by establishing a beacon at the angle of the breakwater, and a portion of the two arms above referred to was built. Work was in progress at the close of the fiscal year.

The capacity of the quarry at Mason Island has been increased to about 400 tons per day, and a Government tug and barge have been prepared for this work. A powerful steamer and five barges have been chartered for the summer and fall.

In this exposed situation it is proposed to take advantage of favorable weather during these seasons for putting stone in the work. About 3,000 tons have been already placed in the arms above referred to, in

addition to the stone required for the beacon, which has been maintained to mark the position of the submerged stone since the commencement of the work. Mr. Wm. Babcock Poland is the local superintendent.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is to finish the construction of the breakwaters.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance on hand and the funds asked for, $300,000, to continuing the construction of the breakwaters.

Point Judith is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $1,878.91. The nearest light-house is Point Judith Light. The nearest fortification is the fort on Dutch Island, Rhode Island. The population of South Kingston by the Rhode Island State census of 1885 was 5,549.

Money statement.

Amount appropriated by act approved September 19, 1890	$75,000.00
June 30, 1891, amount expended during fiscal year	24,671.15
July 1, 1891, balance unexpended	50,328.85
July 1, 1891, outstanding liabilities	6,028.85
July 1, 1891, balance available	44,300.00
Amount (estimated) required for completion of existing project	1,175,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	300,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and placing riprap granite in the breakwater at Point Judith, Rhode Island, received at Engineer Office, U. S. Army, Newport, R. I., in response to an advertisement dated December 5, 1890, and opened at 12 o'clock, noon, on Monday, the 5th day of January, 1891.

[To be commenced on or before March 15, 1891, and completed by December 31, 1891.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	James Scully, Groton, Conn	$1.35
2	Francis H. Smith, New York, N. Y	2.69

C 16.

HARBOR OF REFUGE AT BLOCK ISLAND, RHODE ISLAND.

This island is a part of the State of Rhode Island; it is 14 miles east of Montauk Point, the eastern end of Long Island, and its nearest point is about 10 miles from the mainland. Besides the wants of the mackerel-fishing fleet and the general coast navigation the island is an important point on our shores for ocean navigation. It has a signal station

connected by submarine telegraph with the mainland. Vessels are passing the island at all times and on all sides of it, and its position renders it of national importance. The object of the improvement is to furnish a harbor of refuge for vessels engaged in foreign and coastwise commerce. The mean rise and fall of the tide is about 3 feet.

ORIGINAL CONDITION.

Before the construction of the present harbor of refuge Block Island had no harbor which afforded protection for decked vessels. The only ones used were open boats, which, on the approach of storms, were hauled up on the beach by oxen. The largest of these boats were of about 10 tons burden.

PLANS OF THE WORK.

The original project and its subsequent modifications provided for a harbor of refuge on the eastern side of the island, consisting of an inner harbor or basin for small vessels and an exterior harbor for large ones. The basin was to be about 250 by 300 feet in area, and inclosed, with the exception of an opening 80 feet in width. The exterior harbor was to be formed by a riprap breakwater, which has been built. About 300 feet from the sea end of this breakwater, which is 1,000 feet long, a gap 200 feet long was left for the convenience of vessels. The present project contemplates the enlargement of the inner harbor. A plat of Block Island, showing the position of the harbor of refuge and a plan of the works, may be found in the Report of the Chief of Engineers for 1885, vol. 1, pages 612, 613.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The total expenditures up to June 30, 1890, including liabilities outstanding at that date, was $354,125.59.

The inner harbor and the main breakwater, built in prolongation of the eastern side of the inner harbor, and extending 1,900 feet from the shore, were constructed in the years 1870 to 1879, inclusive. The utility of the work at once became apparent. In stormy weather the inner harbor especially was filled with fishermen and coasters, and it soon became necessary to increase its depth from 7 feet, to which it had been dredged in the first instance, to 9 feet at mean low water. A strong jetty had been built out from the cliff to the eastward of the inner harbor and a masonry wall constructed on the inside of the crib work forming the eastern side of the inner harbor. The filling of the gap in the main breakwater had been completed. The timber jetty filled with stone, forming the shore end of the western wall of the enlarged inner harbor, and about 160 feet of its north wall east of the opening into the harbor had been finished, and about 140 feet of the wall west of the opening built to the level of mean high water. The shoal west of the breakwater had been dredged to 9 feet at mean low water from the steamboat wharf to within 100 feet of the north wall.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $15,000 for the continuation of this work, and a project for the expenditure of this sum

was prepared and was approved by the Chief of Engineers. The project contemplates continuing the construction of the riprap walls of the enlarged inner harbor.

Advertisements for proposals for riprap granite were issued December 5, 1890, and proposals opened January 5, 1891. But one bid was received, and this was rejected.

An abstract of the proposals received will be found in the appended table.

Work was resumed on the north wall of the enlarged inner harbor and 3,711 tons of riprap granite were placed in it. The result was the extension of the north wall of the enlarged inner harber to the westward, the foundation reaching to within 50 feet of the end. The stone delivered was taken from Mason Island Quarry, which is operated by the Government.

Mr. F. I. Angell was the local superintendent of the work.

WHARF AT BLOCK ISLAND.

By act of September 19, 1890, the wharf on the land side of the inner harbor was conveyed to the town of New Shoreham "for the public use of said town; but no tolls or charges shall ever be exacted for the use of said wharf by public vessels of the United States or freight carried in such vessels."

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the completion of the filling of the gap in the main breakwater, the restoration of the breakwater to its original dimensions, and the enlargement of the inner harbor.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to apply the balance of the funds on hand and the appropriation asked for, $24,000, to the continuation of the work according to the existing project.

Block Island is in the Newport collection district, and Newport is the nearest port of entry. The revenue collected in Newport in the last fiscal year was $1,878.91. There is no duty collected at the island. The value of the harbor is mainly as a harbor of refuge. There are several lights at the island. The nearest fortification is Fort Adams, R. I.

Money statement.

July 1, 1890, balance unexpended	$2,171.48
Amount appropriated by act approved September 19, 1890	15,000.00
	17,171.48
June 30, 1891, amount expended during fiscal year	7,726.45
July 1, 1891, balance unexpended	9,445.03
July 1, 1891, outstanding liabilities	4,861.03
July 1, 1891, balance available	4,584.00
Amount (estimated) required for completion of existing project	24,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	24,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and placing riprap granite in the north wall of the inner harbor at Block Island, R. I., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement issued December 5, 1890, and opened at 12 o'clock, noon, on Monday, the 5th day of January, 1891.

[To be commenced not later than March 15, 1891, and completed by December 31, 1891.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	James Scully, Groton, Conn	$1.80

COMMERCIAL STATISTICS.

[Furnished by Hon. Nicholas Ball, Block Island.]

Imports and exports.

Article.	1888.	1889.	1890.
	Tons.	*Tons.*	*Tons.*
Coal received (about)	5,500	6,200	6,500
Iron received (about)	275	300	300
Grain received (about)	2,325	2,400	495
Lumber received (about)	5,592	5,722	5,850
General merchandise, not included in the above	15,500	16,200	16,500

Arrivals and departures.

	1888.	1889.	1890.
Steamers	2,200	2,400	2,550
Sailing vessels	116,000	117,000	117,400

C 17.

IMPROVEMENT OF PAWCATUCK RIVER, RHODE ISLAND AND CONNECTICUT.

The navigable part of Pawcatuck River extends from the manufacturing town of Westerly to Little Narragansett Bay, into which it empties. The approach to the river is through Stonington Outer Harbor and Little Narragansett Bay, and the object of the improvement is to deepen and widen the river channel leading from this bay to Westerly.

The mean rise and fall of the tide is 2.60 feet at the mouth of the river and 2.30 feet at Westerly.

ORIGINAL CONDITION.

Before improvement the channel was crooked and obstructed by numerous shoals, on some of which there was but 1½ feet at mean low water.

PLAN OF IMPROVEMENT.

By means of appropriations made in the years 1871–1875, the river was improved by the United States by the excavation of a channel 5½ feet deep at mean low water and 75 feet wide below the wharves, and from 35 to 40 feet wide between the lower and upper wharves. The present project contemplates the widening of the channel to 100 feet below the wharves and by an additional width of two cuts of an ordinary dredging machine, or about 40 feet between the lower and the upper wharves also the deepening of the entire channel to 8 feet at mean low water.

A plat of Pawcatuck River, showing the channel lines under the present project, was published in the Annual Report of the Chief of Engineers for 1885, Part I, pages 623–625.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on the present project up to June 30, 1890, including liabilities outstanding, was $20,862.62, and the result was the completion of the channel to its full width and depth from the deep water opposite the village of Lottery to a point near the upper end of Major Island and the removal to a depth of 8 feet at mean low water of the ledges at Certain Draw Point and Pawcatuck Rock.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress.

By act of September 19, 1890, Congress appropriated $16,600 for the completion of this improvement. A project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. This project contemplates the extension of the channel, 100 feet wide and 8 feet deep, from the upper end of the work to Westerly and from the lower to the upper wharves with a width of 40 feet and depth of 8 feet.

Advertisements for proposals for dredging were issued November 21, 1890, and proposals opened December 22, 1890. An abstract of proposals received and the terms of the contract will be found in the appended tables. Work was commenced under this contract April 28, 1891, and was in progress at the end of the fiscal year. Seventeen thousand three hundred and sixteen cubic yards of sand and gravel were dredged, extending the channel about 1,000 feet toward Westerly.

Mr. A. H. Dickens is the local inspector.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is the dredging of the channel to a depth of 8 feet at mean low water and a width of 100 feet from the upper end of the present work to Westerly, and a width of 40 feet between the upper and lower wharves of that town.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

It is proposed to complete the work.

Pawcatuck River is in the collection districts of Providence and Stonington, the dividing line passing through the river. Providence and Stonington are the nearest ports of entry. The revenue collected in the last fiscal year was: Providence, $328,849.56; Stonington, $1,808.18. The nearest light-houses are the Stonington and Watch Hill lights. The nearest fortification is Fort Trumbull, New London, Conn.

Money statement.

July 1, 1890, balance unexpended		$482.04
Received by Treasury settlement		13.08
Amount appropriated by act approved September 19, 1890		16,600.00
		17,095.12
June 30, 1891, amount expended during fiscal year		6,260.43
July 1, 1891, balance unexpended		10,834.69
July 1, 1891, outstanding liabilities	$3,286.05	
July 1, 1891, amount covered by uncompleted contracts	3,663.64	
		6,949.69
July 1, 1891, balance available		3,885.00

Abstract of proposals for dredging in Pawcatuck River, Rhode Island, received at Engineer Office, U. S. A., Newport, R. I., in response to advertisement dated November 21, 1890, and opened at 12 o'clock noon on Monday, the 22d day of December, 1890.

[To be commenced on or before March 15 1891, unless otherwise agreed in writing, and completed by December 31, 1891.]

No.	Name and address of bidder.	Per cubic yard.
1	Hartford Dredging Company, Hartford, Conn	$0.21
2	J. H. Fenner, Jersey City, N. J	.28
3	Edgar W. Payn, Albany, N. Y	.35$\frac{9}{10}$

COMMERCIAL STATISTICS.

[Furnished by Messrs. Maxson & Co., Westerly, R. I.]

Receipts.

Articles.	1888.	1889.	1890.
	Tons.	*Tons.*	
Coal	18,894	17,014	16,681
Sand	892	1,275	1,255
Lumber	5,399	5,256	5,575
Bricks	2,391	702	2,248
Grain	2,130	2,180	1,833
Iron	925	1,094	1,075

Shipments.

Stone	2,180	4,664	4,664
Lumber	.....	107	.....

Number of passengers carried by steamers in 1890, 33,100.

C 18.

HARBOR OF REFUGE AT STONINGTON, CONNECTICUT.

Stonington Harbor lies on the north side of the eastern entrance from the ocean into Long Island Sound, and the main object of the improvement is to furnish a harbor of refuge for vessels entering and leaving this entrance to the sound. The mean rise and fall of the tide is about $2\frac{3}{4}$ feet.

ORIGINAL CONDITION.

Originally it was an open bay, unprotected from southerly storms, and obstructed by a shoal, having a low-water depth of but 6 feet at the shoalest part. This shoal nearly filled the inner harbor, and left but a narrow channel on either side of a depth insufficient to permit vessels of 12 feet draft to reach the upper wharves at low water.

PLANS OF THE WORK.

A short breakwater was constructed in the years 1828–1831, at a cost of $34,766.65, for the protection of the commerce of the town of Stonington. The enlarged project of 1871 for the improvement of Stonington Harbor and its subsequent modification, under which work is now carried on, embraced dredging in the upper harbor and the construction of two breakwaters in the outer harbor. One of these (the western) was to be built out from Wamphassuck Point, the southwest limit of the harbor, and to extend about 2,000 feet, and the other (the eastern) was to extend from the vicinity of Bartlett Reef to the Middle Ground. The western breakwater was completed in 1880, at a cost of $103,190. The amount expended in dredging the upper harbor was about $45,000. The position of the western end of the eastern breakwater has not been determined, but it will probably be found necessary, in order to afford all the protection desired, to extend the breakwater at least until it intersects a range from Stonington Light to the middle of Wicopessit Island. It may then be found desirable to carry it still farther, possibly to the range from Stonington Light to the eastern end of Fisher Island.

A plat of this harbor, showing the position of the breakwaters, was published in the Annual Report of the Chief of Engineers for 1884, page 632.

AMOUNT EXPENDED AND RESULTS TO JUNE 30, 1890.

The amount expended on the eastern breakwater up to the close of the fiscal year ending June 30, 1890, including liabilities outstanding at that date, was $115,852.23, and its length at that date was 2,290 feet.

OPERATIONS DURING THE LAST FISCAL YEAR.

At the beginning of the last fiscal year no work was in progress. By act of September 19, 1890, Congress appropriated $12,500 for the continuation of this improvement. A project for the expenditure of this sum was prepared and was approved by the Chief of Engineers. The project contemplates the extension of the eastern breakwater to the westward as far as the funds will permit. Advertisements for proposals for riprap granite were issued December 5, 1890, and proposals opened January 5, 1891. But one bid was received, and was rejected. An abstract of the proposals received will be found in the appended table.

Work was commenced December 10, 1890, and was in progress at the end of the fiscal year. Ten thousand seven hundred and one tons of stone from Mason Island Quarry were placed in the work. The result was the extension of the eastern breakwater to a point about 2,377 feet from its eastern extremity.

WORK REQUIRED TO COMPLETE THE EXISTING PROJECT.

The work required to complete the existing project is to finish the construction of the eastern breakwater. In case it be found that sufficient protection to the harbor of refuge has been afforded when the range from Stonington Light to the middle of Wicopessit Island is reached, the length of the breakwater yet to be built is about 193 feet. Should it be decided to extend it to the middle ground it will require about 100 feet more.

The completion of this work will afford a thoroughly protected anchorage for vessels drawing 18 feet of water and a harbor of refuge for the commerce which daily passes between Long Island Sound and the eastward.

OPERATIONS CONTEMPLATED FOR THE FISCAL YEAR ENDING JUNE 30, 1892.

If an appropriation is made it is proposed to extend the eastern breakwater further to the westward.

Stonington Harbor is in the Stonington collection district and is a port of entry. The amount of revenue collected at Stonington in the last fiscal year was $1,808.18. The principal value of the harbor is as a harbor of refuge. The nearest lights are Stonington Light and Latimer Reef Light. The nearest fortification is Fort Trumbull, New London Harbor, Connecticut.

Money statement.

July 1, 1890, balance unexpended	$137.69
Received by Treasury settlement	24.89
Amount appropriated by act approved September 19, 1890	12,500.00
	12,662.58
June 30, 1891, amount expended during fiscal year	9,462.38
July 1, 1891, balance unexpended	3,200.20
July 1, 1891, outstanding liabilities	2,710.20
July 1, 1891, balance available	490.00
Amount (estimated) required for completion of existing project	12,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	12,500.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for furnishing and placing riprap granite in the eastern breakwater at Stonington, Conn., received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated December 5, 1890, and opened at 12 o'clock noon on Monday, the 5th day of January, 1891.

[To be commenced on or before March 15, 1891, and completed by December 31, 1891.]

No.	Name and address of bidder.	Price per ton of 2,000 pounds.
1	James Scully, Groton, Conn	$1.05

COMMERCIAL STATISTICS.

[Furnished by Mr. Charles Y. Stanton, collector of customs.]

Receipts and shipments for 1891.

	Tons.
Receipts—	
Coal	67,680
Iron	4,075
Steel rails	4,000
Bricks	3,000
Lumber	7,000
Grain	1,600
Sand	1,300
Oil	700
By steamers of Providence and Stonington Steamship Company	200,000
Shipments—	
By steamers of Providence and Stonington Steamship Company	220,000

The steamers of Providence and Stonington Steamship Company carry 80,000 passengers annually.

C 19.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

WRECK OF SCHOONER BENJAMIN GARTSIDE.

At the beginning of the last fiscal year the work of removing the wreck of the schooner *Benjamin Gartside* was in progress under a contract described in the Annual Report for 1890. The work was completed September 15, 1890.

The following property was recovered from the wreck and was sold at auction October 2 and 3, 1890: 1 anchor, 1,262 pounds; about 80 fathoms anchor chain; 1 lot scrap iron; 1 topmast, and about 375 tons stove coal. The proceeds of the sale, amounting to $801.10, were covered into the Treasury, to the credit of the appropriation for removing sunken vessels or craft obstructing or endangering navigation, indefinite, in accordance with the provisions of section 4 of the river and harbor appropriation act of June 14, 1880.

WRECK OF SCHOONER WEYBOSSET.

The schooner *Weybosset* was loaded with paving stone, and was bound from Portland, Me., to Philadelphia, Pa. Her dimensions were approximately as follows: Gross tonnage, 629.6; length, 167.9 feet; breadth, 31.5 feet; depth, 16.3 feet. She was built in 1864 at Mystic, Conn., and was owned by William F. Green & Son, of Boston, Mass.

On August 13, 1890, she struck on the broken ground of Pollock Rip, and sank in 25 feet of water about 700 feet SSW. of the bell buoy north of Pollock Rip light-ship.

The notice required by section 4 of the river and harbor appropriation act of June 14, 1880, to all persons interested in the vessel, etc., was given by advertisement in newspapers, and proposals for removing the wreck were invited. No action having been taken by the owners, the proposals were opened September 26, 1890.

An abstract of the proposals received and the terms of the contract will be found in the appended table.

The removal of the wreck was completed June 6, 1891. Mr. George F. Rostock was local inspector until January 11, 1891, and Andrew R. Elliot after that date. The work was greatly delayed by unfavorable weather and the exposed situation of the wreck.

Abstract of proposals for removing wreck of schooner Weybosset, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated August 27, 1890, and opened at 12 o'clock noon on Friday, the 26th day of September, 1890.

No.	Name and address of bidder.	Amount of bid.
1	James Baker, Boston, Mass	$15,000
2	Boston Towboat Company, Boston, Mass	30,000
3	William E. Chapman, New York, N. Y	39,700

Contract awarded to James Baker, with approval of the Chief of Engineers, and dated October 7, 1890. To be commenced within 10 days after approval of contract by the Chief of Engineers, and completed within 60 days after commencement.

WRECK OF SCHOONER JOSIAH WHITEHOUSE.

The schooner *Josiah Whitehouse* was in collision with an unknown schooner October 12, 1890, 3¾ miles N. by W. ½ W. from Gay Head Light, and sank in 13 fathoms of water. The vessel was loaded with coal, and her dimensions were approximately as follows: Gross tonnage, 276.33; length, 118 feet; breadth, 29 feet; depth, 10 feet. She was built in 1864 at Waldoboro, Me.

The notice required by section 4 of the river and harbor act of June 14, 1880, to all persons interested in the vessel, etc., was given by advertisements in newspapers, and proposals for the removal of the wreck were invited. No action having been taken by the owners the proposals were opened December 1, 1890.

The specifications required the removal of all parts of the wreck to a depth of 50 feet at mean low water. This necessitated only the removal of masts and rigging.

An abstract of the proposals received and the terms of the contract will be found in the appended table.

The work of the removal of the wreck was completed December 31, 1891.

Mr. W. C. Simmons, assistant engineer, was in local charge of this work.

Abstract of proposals for removing wreck of schooner Josiah Whitehouse, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated November 1, 1890, and opened at 12 o'clock noon on Monday, the 1st day of December, 1890.

No.	Name and address of bidder.	Amount of bid.
1	Charles E. Davis, Woods Holl, Mass	$390
2	Charles W. Johnston, Lewes, Del	425
3	Elijah D. Rejister, Lewes, Del	700
4	Hiram W. Phillips, Quincy Point, Mass	850
5	Geo. W. Townsend, Boston Mass	870
6	Boston Towboat Co., Boston, Mass	965
7	Wm. E. Chapman, New York, N. Y	2,000

Contract awarded to Charles E. Davis, of Woods Holl, Mass., with approval of the Chief of Engineers, and dated December 18, 1891, to be commenced within 10 days after the approval of the Chief of Engineers, and completed within 10 days after commencement.

WRECK OF SCHOONER S. S. BICKMORE.

The schooner *S. S. Bickmore* was loaded with lime, and was bound from Thomaston, Me., to New York. On or about October 20, 1890, she caught fire and sank in 15 feet of water in Hyannis Harbor, directly in

the anchorage area, about half way between the wharf and the west end of the breakwater. Her dimensions were approximately as follows: Gross tonnage, 224.88; length, 110 feet; breadth, 29.1 feet; depth, 9.1 feet. She was built in 1867 at St. George, Me.

The notice required by river and harbor appropriation act of June 14, 1880, to all persons interested in the vessel, etc., was given by advertisement in newspapers, and proposals for removing the wreck were invited. No action having been taken by the owners the proposals were opened December 27, 1890.

An abstract of the proposals received and the terms of the contract will be found in the appended table.

The work of the removal of the wreck was finished June 6, 1891, having been delayed by inclement weather and a serious accident to the contractor's plant. Mr. George F. Rostock was the local inspector.

Abstract of proposals for removing wreck of schooner S. S. Bickmore, received at Engineer Office, U. S. Army, Newport, R. I., in response to advertisement dated November 26, 1890, and opened at 12 o'clock noon on Saturday, the 27th day of December, 1890.

No.	Name and address of bidder.	Amount of bid.
1	Hiram W. Phillips, Quincy Point, Mass	$1,500
2	George W. Townsend, Boston, Mass	2,373
3	James Baker, Boston, Mass	3,700

Contract awarded to Hiram W. Phillips, with approval of the Chief of Engineers, and dated January 22, 1891, to be commenced within 10 days of approval of contract, and completed within 60 days of time of commencement.

C 20.

PRELIMINARY EXAMINATION OF NARRAGANSETT BAY CHANNEL, RHODE ISLAND, BETWEEN STARVE GOAT ISLAND AND THE MAIN LAND, WITH A VIEW OF DEEPENING THE SAME.

[Printed in House Ex. Doc. No. 173, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 14, 1891.

SIR: I have the honor to submit the accompanying copy of report, dated December 19, 1890, from Maj. W. R. Livermore, Corps of Engineers, giving results of preliminary examination of Narragansett Bay Channel, Rhode Island, "between Starve Goat Island and the mainland, with a view of deepening the same," made to comply with provisions of the river and harbor act approved September 19, 1890.

Major Livermore reports that this improvement can not be regarded as of great benefit to the general commerce of the country, and, therefore, not worthy of being made by the General Government. Col. H. L. Abbot, Corps of Engineers, division engineer, northeast division, concurs in this opinion, and the views of these officers meet with my approval.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR W. R. LIVERMORE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 19, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Narragansett Bay Channel between Starve Goat Island and the mainland, provided for in river and harbor act of September 19, 1890, and made by me from time to time, especially in July and August, 1890.

The improvement desired is the dredging of a channel about one-half mile long, 200 feet wide, and 10 feet deep at mean low water, from the wharves of Pawtuxet to the deep water of Narragansett Bay.

The town of Pawtuxet is about 4 miles south of Providence, on the west shore of Narragansett Bay. Those who ask for this improvement are Providence business men, residing at Pawtuxet and along the shore north of the town, who desire a better means of communication between their homes and offices than is afforded by the street cars. Such a means of communication would be furnished by the river steamers, should this project be carried out.

This improvement can not be regarded as of great benefit to the general commerce of the country, and for this reason, in my opinion, Narragansett Bay Channel between Starve Goat Island and the mainland is not worthy of improvement by the General Government.

Narragansett Bay Channel is in the collection district of Providence, which is a port of entry. The amount of revenue collected at Providence during the last fiscal year was $269,858. The nearest light-houses are the six light-houses in Providence River. The nearest fortifications are fort on Dutch Island and Fort Adams, R. I.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, January 8, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

I concur with Major Livermore in considering that Narragansett Bay Channel between Starve Goat Island and the mainland is not worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers,
Bvt. Brig. Gen., U. S. A.,
Engineer, Northeast Division.

C 21.

PRELIMINARY EXAMINATION OF WATCH HILL COVE, RHODE ISLAND, IN LITTLE NARRAGANSETT BAY.

[Printed in House Ex. Doc. No. 174. Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., January 14, 1891.

SIR: I have the honor to submit the accompanying copy of report dated December 19, 1890, from Maj. W. R. Livermore, Corps of Engineers, giving results of preliminary examination of Watch Hill Cove, in Little Narragansett Bay, Rhode Island, made to comply with provisions of the river and harbor act approved September 19, 1890.

Col. H. L. Abbot, Corps of Engineers, division engineer, northeast division, in forwarding this report concurs in the opinion of Major Livermore that this locality is not worthy of improvement by the General Government, and I approve of the views of these officers.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF MAJOR W. R. LIVERMORE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 19, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Watch Hill Cove, in Little Narragansett Bay, provided for in river and harbor act of September 19, 1890, and made by me on the 5th of November last:

Watch Hill is at the southeast corner of Little Narragansett Bay; and the cove, in which are situated the small wharves belonging to the settlement at Watch Hill, is separated from Block Island Sound by a narrow sand beach.

At Watch Hill is a light-house, a life-saving station, several large hotels, and cottages. The only business is that of a summer watering place, and as such Watch Hill is yearly increasing in importance.

No boats touch at this point except excursion steamers and other light-draft vessels during the summer months.

The improvement desired is the dredging of a channel of sufficient depth to accommodate such vessels as touch at Watch Hill to a point in the southeastern part of the cove; there is now enough water for steamers to land a short distance north of this point.

This improvement is asked for the benefit of steamers running to Watch Hill from Westerly, Stonington, Norwich, and New London, for the accommodation of summer visitors, which can not be regarded as in the interest of general commerce. For this reason, in my opinion, Watch Hill Cove, in Little Narragansett Bay, is not worthy of improvement by the General Government.

Watch Hill Cove is in the collection district of Stonington, which is

a port of entry. The revenue collected at Stonington during the last fiscal year was $1,590. The nearest light-house is Watch Hill Light. The nearest fortification is Fort Trumbull, New London, Conn.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division.)

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, January 8, 1891.

Respectfully forwarded to the Chief of Engineers.

I concur with Major Livermore in considering that Watch Hill Cove, in Little Narragansett Bay, is not worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer, Northeast Division.

C 22.

PRELIMINARY EXAMINATION OF NEWPORT HARBOR, RHODE ISLAND, SOUTH OF GOAT ISLAND, WITH A VIEW TO THE REMOVAL OF THE SPIT AT THE SOUTH END OF THE ISLAND.

[Printed in House Ex. Doc. No. 180, Fifty-first Congress, second session.]

ENGINEER OFFICE, U. S. ARMY,
Newport, R. I., December 19, 1890.

GENERAL: In compliance with instructions contained in Department letter of September 20, 1890, I have the honor to submit the following report upon the preliminary examination of Newport Harbor, south of Goat Island, provided for in river and harbor act of September 19, 1890, and made by me frequently from time to time.

Goat Island lies due west of Newport, in such position that all vessels entering the harbor by the south entrance are compelled to make a detour around the sand spit at the southern end of the island. This bank extends about 800 feet southeasterly from the island, the depth being in some places less than 1 foot at mean low water.

The improvement desired is the removal of this shoal to a depth of 15 feet at mean low water. This improvement would open a portion of the old channel as an anchorage area equal to about three times the area dredged.

Borings made October 4–9 last show this bank to be composed of mud, gravel, and clay.

In my opinion Newport Harbor south of Goat Island is worthy of improvement by the General Government. The expense is estimated as follows:

88,000 cubic yards excavation, at 25 cents per yard	$22,000
Add 10 per cent. for contingencies	2,200
Total	24,200

Newport Harbor is in the collection district of Newport, which is a port of entry. The amount of revenue collected at Newport in the last fiscal year was $2,184.51. The nearest light-house is Lime Rock Light. The nearest fortification is Fort Adams, Newport, R. I. The population of Newport by the State census of 1885 was 19,556.

Very respectfully, your obedient servant,

W. R. LIVERMORE,
Major of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

(Through Col. H. L. Abbot, Corps of Engineers, Division Engineer, Northeast Division).

[First indorsement.]

NORTHEAST DIVISION, ENGINEER OFFICE,
New York, January 8, 1891.

Respectfully forwarded to the Chief of Engineers, U. S. Army.

I concur with Major Livermore in considering that Newport Harbor below Goat Island, is worthy of improvement.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
Engineer, Northeast Division.

APPENDIX D.

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT, AND OF RIVERS AND HARBORS ON LONG ISLAND SOUND, CONNECTICUT AND NEW YORK, AND ON SOUTHERN SHORE OF LONG ISLAND, NEW YORK.

REPORT OF COLONEL D. C. HOUSTON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Mystic River, Connecticut.
2. Thames River, Connecticut.
3. New London Harbor, Connecticut.
4. Connecticut River, Massachusetts and Connecticut.
5. Harbor of refuge at Duck Island Harbor, Connecticut.
6. Clinton Harbor, Connecticut.
7. New Haven Harbor, Connecticut.
8. Breakwater at New Haven, Connecticut.
9. Milford Harbor, Connecticut.
10. Housatonic River, Connecticut.
11. Bridgeport Harbor, Connecticut.
12. Black Rock Harbor, Connecticut.
13. Norwalk Harbor, Connecticut.
14. Harbor at Wilson Point, Connecticut.
15. Five Mile River Harbor, Connecticut.
16. Stamford Harbor, Connecticut.
17. Port Chester Harbor, New York.
18. Larchmont Harbor, New York.
19. Echo Harbor, New Rochelle, New York.
20. New Rochelle Harbor, New York.
21. East Chester Creek, New York.
22. Greenport Harbor, New York.
23. Port Jefferson Harbor, New York.
24. Huntington Harbor, New York.
25. Glen Cove Harbor, New York.
26. Flushing Bay, New York.
27. Patchogue River, New York.
28. Browns Creek, Sayville, New York.

EXAMINATIONS AND SURVEYS.

29. Stony Creek River at Stony Creek, Connecticut.
30. Shaw's Cove, New London Harbor, Connecticut.
31. Connecticut River, from Long Island Sound to Hartford, and below Hartford, Connecticut.
32. Saugatuck River, Connecticut.
33. Mattituck Bay, Suffolk County, New York, for breakwater.
34. Stamford Harbor, Stamford, Connecticut.
35. Cos Cob or Miamus River, Connecticut.
36. Peconic River, Suffolk County, New York.
37. Sag Harbor, Suffolk County, New York, for breakwater.

ENGINEER OFFICE, U. S. ARMY,
New York, July 10, 1891.

GENERAL: I have the honor to transmit herewith the annual reports upon the works of river and harbor improvement under my charge for the fiscal year ending June 30, 1891.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

D 1.

IMPROVEMENT OF MYSTIC RIVER, CONNECTICUT.

Mystic River is a narrow tidal stream in the eastern part of the State of Connecticut, about 7 miles west from the boundary of the State of Rhode Island. The navigable part of the river extends in a general north-northeasterly direction for nearly 4 miles from Fisher Island Sound, past the villages of Noank, Mystic River, and Mystic Bridge, above which places it receives the discharge of several small fresh-water streams. The villages of Mystic River and Mystic Bridge lie respectively on the west and east banks of the river, opposite each other and about 3 miles above Fisher Island Sound; at this point the river is crossed by a highway bridge with a draw. Nearly a half mile farther down is the drawbridge of the New York, Providence and Boston Railroad, and about 1½ miles still farther the village of Noank lies upon the west bank. The population of Mystic River and Mystic Bridge together is about 4,000; that of Noank, about 2,000.

Directly opposite the mouth of the river lie Mystic or Ram Island and Ram Island Shoal, which cause the channel to divide and branch off sharply to the northeast and southwest. The northeast channel is 18 feet or more in depth and of sufficient width, but crooked; it is the one used by large vessels; the southeast channel opens out into a broad flat with about 12 feet available depth.

The river channel up to within about a half mile below the highway bridge has a low-water depth of 15 feet or more; its width, from 80 to 300 feet, is sufficient, but there are several bends in its course which make it somewhat difficult of navigation. The mean rise of tide in Mystic River is about 2½ feet.

PROJECT FOR IMPROVEMENT.

Under act of Congress of August 11, 1888, a preliminary examination of Mystic River was made. In the report on this examination, dated October 26, 1888, and printed in the Annual Report of the Chief of Engineers for 1889, Part 1, page 746, a project for improvement was submitted, which consisted in dredging to make the channel 15 feet at mean low water and 100 feet wide and to reduce five bends in the channel. The estimate of cost, based upon the U. S. Coast Survey chart of 1882, was as follows:

160,000 cubic yards, at 16 cents	$25,600
Supervision and contingencies, say	4,400
Total	30,000

The beginning of work under this project was approved by the Secretary of War, November 1, 1890, after the first appropriation for improving the river had been made.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $10,000 were appropriated for this improvement. After advertisement, proposals for dredging were opened and under date of March 25, 1891, a contract was entered into with the Hartford Dredging Company, of Hartford, Conn., to do the required dredging at the rate of 14$\frac{7}{10}$ cents per cubic yard,

measured in scows. Actual work under this contract was begun April 22, and up to May 16, 10,821 cubic yards had been excavated from the channel between the highway bridge and the railroad bridge, making the channel 15 feet deep at mean low water and about 50 feet wide for nearly the whole distance between the bridges. On May 16, with consent of parties interested in the improvement, work was temporarily suspended; it will be resumed early in July.

PRESENT CONDITION OF IMPROVEMENT.

The present condition of improvement is as stated above, the work done under the contract not yet completed being the only public work of improvement done in this river.

PROPOSED OPERATIONS.

Under the contract still in force the channel above and just below the railroad bridge will be completed and one of the bends farther downstream will be widened as far as the funds available will admit of.

With future appropriations it is proposed to reduce the remaining bends in the channel, in accordance with the approved project.

The average annual cost of maintaining the channel of Mystic River is estimated at $2,000.

The only appropriation made for this improvement is that of $10,000, by act of Congress approved September 19, 1890.

Mystic River is in the New London collection district, of which New London is the port of entry. The nearest work of defense is Fort Griswold, New London Harbor, about 6 miles west. There is a light-house on Morgan Point, on the west side of the river at its mouth.

Money statement.

Amount appropriated by act approved September 19, 1890		$10,000.00
June 30, 1891, amount expended during fiscal year		1,644.33
July 1, 1891, balance unexpended		8,355.67
July 1, 1891, outstanding liabilities	$159.06	
July 1, 1891, amount covered by uncompleted contracts	5,759.31	
		5,918.37
July 1, 1891, balance available		2,437.30
Amount (estimated) required for completion of existing project		20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Mystic River, Connecticut, opened March 12, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard (50,000 cubic yards).	Amount of bid.	Remarks.
1	Edgar M. Payn, Albany, N. Y.	$0.14 2/10	$7,450.00	
2	Chas. M. Cole, Fall River, Mass	.17 3/8	8,687.50	
3	Elijah Brainard, New York City	.18	9,000.00	
*4	The Hartford Dedging Company, Hartford, Conn.	.14 7/10	7,350.00	Lowest bid.
5	Charles DuBois and Henry E. DuBois, New York City.	.20	10,000.00	

* Entered into contract March 25, 1891; in progress.

NOTE.—Amount available for contract work about $8,000.

No commercial statistics for the calendar year 1890 have been received.

D 2.

IMPROVEMENT OF THAMES RIVER, CONNECTICUT.

This river is formed by the confluence of the Yantic and Shetucket Rivers, at Norwich, Conn., and extends southward as a tidal stream 15 miles to Long Island Sound. For 11 miles above its mouth the natural channel is from 13 to 80 feet deep, averaging over 30 feet for the first 4 miles. For 3 miles below Norwich the available depth in 1829 was but 6 feet at mean low water, where now there is 11 feet. Histories of the improvements may be found in the Annual Report of the Chief of Engineers for 1873, page 981, and in that for 1879, Part I, page 331.

PROJECTS FOR IMPROVEMENT.

Prior to 1830 various attempts had been made by private parties or corporations to deepen the channel of this river near Norwich; the first ones were by excavation only, but subsequently stone piers were constructed perpendicular to the channel at shoal spots.

By act of March 2, 1829, Congress appropriated $150 "for making a survey of the river Thames with a view to improve the navigation of the same, and the cost of such improvement."

The survey was made in 1829 by Capt. Hartman Bache, Corps of Engineers. At that time there were four old piers standing. In his report upon the survey, dated February 20, 1830, and printed in House of Representatives, War Department Document, No. 125, Twenty-first Congress, first session, Captain Bache submitted a project for making a channel 60 feet wide, to be either 12 or 14 feet deep at high water (9 or 11 feet at low water) by excavation, by rebuilding one of the existing piers, by adding wings to the other three, extending up and down stream and converting them into T walls, and by building ten new piers, extending downstream in curves. The piers were to be built of riprap 3 feet wide on top, with side slopes of 45 degrees; they were to be built to heights of from 1½ to 3½ feet above highest tide, those farthest up the stream being the highest. The piers were estimated to require 43,436 cubic yards of riprap, and the excavation was placed at 27,895 cubic yards for the 12-foot channel, or 69,251 cubic yards for the 14-foot channel. The cost of the whole work was estimated at $72,650.

The project was adopted, and under appropriations of 1836, 1837, and 1838, $40,000 in all, the piers were built nearly as designed with the exception of two of the new piers and one wing wall, which were not constructed; considerable dredging was done, but no complete record of amounts appears to have been kept.

Work was stopped in 1839 by exhaustion of appropriations.

In 1866 a petition of citizens of Norwich, asking for an appropriation for removing obstructions in the river Thames, was referred to the Chief of Engineers and returned by him to the Secretary of War with a report describing the work done upon the river, recommending no further work on the piers until their efficiency could be investigated satisfactorily, and stating:

> In conclusion it is considered that should the sum of $8,000 be appropriated for the improvement of this river, to be applied during the next fiscal year, all will be accomplished that can be justifiably undertaken until a commission decides upon other efficacious methods or systems of improvement.

June 23, 1866, an appropriation of $10,000 was made for improving the river under which a survey was made, and a project for dredging

to obtain a depth of 11 feet at low water (14 feet at high water) was adopted.

Under this and succeeding appropriations up to 1878, this channel was dredged and as far as possible maintained with a width of 100 feet. March 3, 1879, $12,000 was appropriated "for the improvement of the Thames River to secure a 14-foot channel," and in accordance therewith the project was modified to provide for a channel of that depth at low water.

In 1882, upon recommendation of Major Barlow, approved by the Board of Engineers, the project was further modified by providing for the construction of 5 dikes, or training-walls, along the outer sides of the channel curves, with the addition of low walls on the inner sides should they be found necessary, the width of the water way between them increasing from 300 feet (about the full width of the river) at Thamesville, 1 mile below Norwich, to 480 feet at the lower dike.

The object of the training walls was to utilize the action of the tides to keep the channel open. They were to be built up to high-water level and to have an aggregate length of 13,800 feet. In the same year the projected width of the channel was increased to 200 feet. The improvement was designed to extend over the first 3½ miles below Norwich, and the estimated cost was:

For the five dikes or training walls	$82,800
For dredging 200 feet wide and 14 feet deep	125,280
Total	208,080

Under several appropriations up to 1888 work was carried on under this project without modification.

In May, 1888, in response to a letter from the Hon. Charles Russell, M. C., to the Secretary of War, asking the "approximate cost of completing the 16 feet deep channel to Allyn Point, and the 14 feet deep channel to Norwich," estimates for the same were submitted as follows:

For securing, by dredging, a 16-foot channel up to Allyn Point	$24,000
For securing, by dredging, a 14-foot channel from Allyn Point to the end of the existing improvement	16,200

By act of Congress of August 11, 1888, an appropriation of $50,000 was made for continuing the improvement of Thames River, with a clause authorizing its expenditure "at any point between Norwich and New London." The project was therefore extended to include the above-described work, and as now adopted it consists in making and maintaining, by dredging and by a system of training walls, a channel 200 feet wide from New London to Norwich, having 16 feet depth at low water up to Allyn Point, about 5 miles below Norwich, and 14 feet from Allyn Point to Norwich.

The additional cost of the extension of the project made in 1888, about $40,000, makes the estimate for completion $95,600. The estimated cost of annual maintenance should also be increased to $8,000.

Under this project, up to July 1, 1890, 287,725 cubic yards of sand, etc., had been dredged from the channel above Allyn Point, and 84,890 cubic yards of sand and mud from the 16-foot channels at and below Allyn Point. The three dikes farthest downstream had been built and a fourth one to about three-quarters its contemplated length.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $20,000 was appropriated for this improvement. Proposals for dredging to widen the

channel above Allyn Point were received and a contract was entered March 20, 1891, with Elijah Brainard, of New York City, for dredging about 100,000 cubic yards at the rate of 24½ cents per yard.

Dredging was begun May 21, and up to the close of the fiscal year the channel at Thamesville (1 mile below Norwich) had been made 125 feet wide and the channel opposite Trading Cove (about 2 miles below Norwich) had been nearly completed to that width. The depth made was 12 feet at mean low water, and the amount dredged was 28,414 cubic yards. The contract is still in progress.

PRESENT CONDITION OF IMPROVEMENT.

Of the five dikes or training walls provided for in the project, the four farthest downstream have been built at cost as follows:

	Date of completion.	Length.	No. of tons of riprap, exclusive of repairs.	Cost, exclusive of supervision.
		Feet.		
Mohegan, 3½ miles below Norwich	1883	2,988	(*)	$23,686.00
Trading Cove, 2⅓ miles below Norwich	1882	2,370	17,207	21,113.05
Long Rock, 2 miles below Norwich	1885	2,800	11,945	12,781.15
Rolling Mill, 1½ miles below Norwich	1887	3,093	18,521	18,772.58

* Pile dike.

The Rolling Mill Dike, originally designed to be 4,350 feet long, is now 3,093 feet long, with a gap of 390 feet at the "sand pier," and extends northward nearly to the Lower Rolling Mill embankment.

The project contemplated extending it about 600 feet north of the embankment, but since its adoption the Lower Rolling Mill Company has dredged a channel towards shore on the north side of their embankment, which is now used as a landing. It would be necessary to leave an opening for this channel, and probably it will be found expedient not to extend the dike above the embankment.

The upper dike, one-half mile below Norwich, has not been begun.

The low-water depth in the channel from New London to Allyn Point is not less than 16 feet, with width of 200 feet or over; from Allyn Point to the upper end of the Walden Island Reach the depth is 14 feet and the width not less than 175 feet; above the latter point, up to Norwich, the depth is 11 feet or over, and the width from 75 to 150 feet.

PROPOSED OPERATIONS.

Under the contract in progress the channel above Walden Island will be made 12 feet deep at mean low water, and 125 feet wide or more.

Future appropriations will be applied to completing the dikes, if necessary, and to making and maintaining a channel 200 feet wide, to be 16 feet deep at mean low water up to Allyn Point, and thence to Norwich, to be 14 feet deep, as projected.

Appropriations for the improvement of Thames River have been made as follows :

Application.	Date.	Amount.
Removal of obstructions placed during the war of 1812	Mar. 3, 1821	$150
Survey	Mar. 2, 1829	150
Piers and dredging	July 4, 1836	10, 000
Do	Mar, 3, 1837	20, 000
Do	July 7, 1838	10, 000
Dredging and survey	June 23, 1866	10, 000
Dredging	Mar. 3, 1867	72, 000
Do	Mar. 3, 1871	15, 000
Do	June 10, 1872	10, 000
Do	June 18, 1878	10, 000
Do	Mar. 3, 1879	12, 000
Do	June 14, 1880	22, 500
Dredging and training walls	Mar. 3, 1881	30, 000
Training walls	Aug. 2, 1882	*35, 000
Do	July 5, 1884	*25, 000
Training walls and dredging	Aug. 5, 1886	*22, 500
Repair of training walls and dredging	Aug. 11, 1888	*50, 000
Dredging	Sept. 19, 1890	*20, 000
Total		374, 300

*Appropriated for present project: These, with $20,000 from previous appropriations (see Annual Report for 1882, part 1, page 603), make total of $172,500 for present project.

The Thames River is in the collection district of New London. The nearest lighthouse is at the mouth of the river, on the west shore. Forts Trumbull and Griswold overlook the mouth of the river from either shore.

Money statement.

July 1, 1890, balance unexpended		$17, 437. 64
Amount appropriated by act approved September 19, 1890		20, 000. 00
		37, 437. 64
June 30, 1891, amount expended during fiscal year		8, 535. 86
July 1, 1891, balance unexpended		28, 901. 78
July 1, 1891, outstanding liabilities	$5, 678. 52	
July 1, 1891, amount covered by uncompleted contracts	17, 692. 57	
		23, 371. 09
July 1, 1891, balance available		5, 530. 69
Amount (estimated) required for completion of existing project		75, 600. 00
Amount that can be profitably expended in fiscal year ending June 30, 1893		75, 600. 00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for dredging in Thames River, Connecticut, opened March 9, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard (100,000 cubic yards).	Amount of bid.	Remarks.
1	*Elijah Brainard, New York City	$0. 24½	$24, 500	Lowest bid.
2	The Hartford Dredging Company, Hartford, Conn	.27	27, 000	

NOTE.—Amount available for contract work about $25,000.
* Lowest bid: Entered into contract March 20, 1891; contract in progress.

Abstract of contracts for improving Thames River, Connecticut, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date of contract.	Subject of contract.	Prices.	Remarks.
S. and E. S. Belden, Rocky Hill, Conn.	Apr. 23, 1890	Repair of dikes	Riprap per ton, 96 cents; flatstones per ton, $1.13; removing and depositing stones, per cubic yard, 55 cents.	Contract completed October 18, 1890.
Elijah Brainard, New York City.	Mar. 20, 1891	Dredging	24½ cents per cubic yard.	Contract in progress.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Vessels arriving and departing.

[Draft 4 to 16 feet.]

Vessels.	Number.	Number of round trips.
Steamers	404	202
Sailing vessels	36	18
Barges	370	185
Total	810	405

Freight by water.

	Tons.
Coal received	353,319
Iron received	11,358
Lumber received	11,500
Miscellaneous received	51,187
Miscellaneous shipped	39,780
Total	467,144

The amount of freight reported for 1890 is greater than that reported for 1889 by 63,144 tons. Its total value can not be closely estimated; it is probably in the neighborhood of $25,000,000.

No new lines of transportation have been established since July 1, 1890.

D 3.

IMPROVEMENT OF NEW LONDON HARBOR, CONNECTICUT.

New London Harbor is that part of the Thames River which lies in front of the city of New London, extending from Winthrops Point to Long Island Sound, a distance of 3 miles. It has good anchorage ground and a channel from 30 to 50 feet deep, and a quarter of a mile wide, extending up to Winthrop Point. It is one of the best harbors on the Atlantic coast.

PROJECT FOR IMPROVEMENT.

In the Annual Report for 1878, upon the improvement of Thames River (see Annual Report of the Chief of Engineers for 1878, Part I,

page 397), shortly after the completion of the New London Northern Railroad wharf, a petition of certain citizens of New London and Norwich was presented asking that the United States undertake the removal of a shoal east of that wharf. The desired work was estimated to cost $6,800, and it was recommended that it be included in the general project for the improvement of the Thames River. The estimate was as follows:

To remove the shoal and bowlders to a depth of 16 feet at mean low water will require the excavation of 125 cubic yards of bowlders, at $5 per yard	$625
37,000 cubic yards of gravel and mud, at 15 cents per cubic yard	5,550
Add for contingencies	625
Total	6,800

This shoal extended from the shore out about as far as the end of the wharf. The part whose removal was contemplated was that part lying south of a line running east from a point on the railroad wharf 500 feet from its outer end.

The river and harbor act approved June 14, 1880, appropriated "for the improvement of the Thames River, of which sum $2,500 shall be expended in the removal of rocks and sand from New London Harbor, $25,000."

In 1881 and subsequently appropriations were made for improving New London Harbor.

The first work under this project so inaugurated was done in 1880. It was found that the presence of bowlders made the dredging much more expensive than had been counted on, and in the Annual Report for 1881 (see Annual Report of the Chief of Engineers for 1881, Part I, page 586) a new estimate was submitted, placing the cost from the beginning at $24,000.

In 1882 the project was modified so that the area to be dredged should be that part of the shoal lying southwest of a line running about southeast from a point on the wharf 600 feet from its outer end. The object of this modification was to avoid as far as possible the large bowlders that were found near the crest of the shoal and to keep the cost of the work within the last estimate, while affording no less accommodation to vessels using the wharf. The depth over this part of the shoal was from 5 to 15 feet at mean low water.

Nineteen thousand eight hundred dollars have been appropriated for this work; 22,902 cubic yards of sand and stones and 564 cubic yards of bowlders have been removed.

The proportion of bowlders to mud and gravel in the original estimate was about 1 to 300; the proportion actually found has been about 1 to 41. The actual cost of dredging mud and gravel has averaged 54 cents per cubic yard. The bowlders have ranged in size from one-fourth cubic yard to 5 cubic yards, many of them having to be blasted.

Under provisions of the river and harbor act of 1888 a preliminary examination of the harbor was made, the report on which, printed in the Annual Report of the Chief of Engineers for 1889, Part 1, page 744, presented a plan and estimates for the new improvement desired, viz, deepening the approaches to the city water front, and under provision of the river and harbor act of 1890 a preliminary examination of Shaw Cove, New London Harbor, was made; no survey was considered necessary, and estimates were submitted with the report, dated December 4, 1890, for dredging a channel and anchorage basin in the cove.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

No work was done, the project being substantially completed.

Appropriations for improving New London Harbor have been made as follows, viz:

Application.	Date.	Amount.
Dredging shoal east of railroad wharf	June 14, 1880	*$2,500
Do	Mar. 3, 1881	4,300
Do	Aug. 2, 1882	9,000
Do	July 5, 1884	2,000
Do	Aug. 5, 1886	2,000
Total		19,800

*Part of appropriation for Thames River improvement.

New London, the port of entry for the collection district of New London, is situated on the west bank of the Thames River, about 2½ miles from Long Island Sound. The harbor is the mouth of the Thames River.

New London Light-house is located at the entrance of the harbor on the west shore. Forts Trumbull and Griswold command the harbor from either side.

No commercial statistics for the calendar year 1890 have been received.

D 4.

IMPROVEMENT OF CONNECTICUT RIVER, MASSACHUSETTS AND CONNECTICUT.

This river rises in the northern part of New Hamphshire, flows in a general southerly course between the States of New Hampshire and Vermont, crosses the States of Massachusetts and Connecticut, and empties into Long Island Sound at Saybrook Point, Conn. It is divided naturally into two parts, Hartford, Conn., at the head of navigation being the point of division, and appropriations by Congress have generally specified in which part the money appropriated was to be expended.

The divisions are as follows:

1. *Above Hartford, Connecticut.*—Embracing a length of about 66 miles, from Hartford, Conn., to Miller Falls, Mass.

2. *Below Hartford, Connecticut.*—Embracing a length of about 50 miles, from Hartford to Long Island Sound.

By the river and harbor act of 1882 an examination or survey of the Connecticut River from Bellows Falls, Vt., to Pittsburg, N. H., was authorized. Bellows Falls is about 105 miles above Hartford and Pittsburg is 180 miles above Bellows Falls. A preliminary examination was made, the report on which, printed in the Annual report of the Chief of Engineers for 1884, Part I, page 659, recommended no survey and proposed no plan of improvement.

1. ABOVE HARTFORD, CONNECTICUT.

Miller Falls, Mass., is at the head of possible navigation of the Connecticut River. From this point down to Holyoke, Mass., a distance of about 32 miles, the river is susceptible of improvement, but it can not be used by vessels now on account of a dam and falls at Holyoke which

entirely obstruct navigation. The lockage required to lift boats from the lower to the upper levels at Holyoke is about 60 feet. From Holyoke, Mass., to Enfield Falls, Conn., a distance of 18 miles, there is a fair channel, 4 to 5 feet deep at low water, which could be made 8 feet deep. Enfield Falls or Rapids cover a stretch of river about 5 miles long, having a fall of about 32 feet at low water. The bed is rocky and very uneven, and the slope is not uniform, but consists of a succession of long shallow reaches separated by rapids.

From the foot of Enfield Falls to Hartford, a distance of 11 miles, the river has a broad, sandy bed, with a depth of 2 to 5 feet at low water. Under a charter from the State of Connecticut, granted in May, 1824, the Connecticut River Company has constructed a canal, with locks, around Enfield Falls.

The locks are 80 feet long, 18 feet wide, and 4½ feet deep. The canal is chiefly used for water power; the company collects toll from vessels using it.

Following is a list of places in this part of the river where work has been done by the United States, with distances above the wagon bridge at Hartford:

	Miles.
Barbers Landing	4
Farmington River	5
Strongs Island	6½
Scantic River	7½

PROJECTS FOR IMPROVEMENT.

No general project for the improvement of this part of the river is on record as approved and adopted. All the work done has been under special projects for expenditure of the several appropriations. It consists of dredging at Barbers Landing in 1873, and construction of dikes, or wing dams, at Scantic River, Strongs Island, and Farmington River in 1871, at Farmington River and Barbers Landing in 1878, and again in 1880 and 1881.

Plans and estimates for a larger canal around Enfield Falls were submitted in 1878 and modified in 1880. (See Annual Report of the Chief of Engineers for 1881, Part 1, page 566.) They proposed a canal on the east bank of the river, extending from above Enfield Falls down to the mouth of the Hockanum River, opposite and just below Hartford, as the best means of gaining an available depth of 8 feet from Hartford to and around the falls. The canal levels were to be 10 feet deep at low water, and 120 feet wide at the water line; the locks 200 feet long, 55 feet wide, with 8 feet depth over the miter sills at low water. The cost of the work was estimated at $1,332,805. It was considered not advisable to begin construction with a less sum than $450,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

No work was done. The available money is insufficient to begin any general plan of improvement in this part of the river.

PRESENT CONDITION OF IMPROVEMENT.

The wing dams are all in fair condition; they are as follows: One at Scantic River, 1 at Strongs Island, 1 at the mouth of Farmington River, 2 nearly opposite the mouth of Farmington River, and 2 on the east

bank, opposite Barbers Landing. The available channel depth from Hartford to Scantic River is about 2 feet at ordinary summer stage of water; this part of the river is navigable for freighting only when in freshet. No work has been done above Scantic River; the depth from there up to the foot of Enfield Falls is greater than from there down to Hartford.

PROPOSED OPERATIONS.

No work in the river above Hartford is contemplated during the ensuing year. Should any injury to the wing-dams occur, the money available will be sufficient for repairs.

Appropriations for improving the Connecticut River above Hartford have been made as follows :

Application.	Date.	Amount.
Dams at Scantic River, Strong's Island, Farmington River, and Barber's Landing; repairs of dams ; dredging at Barbers Landing; surveys	July 11, 1870	$20,000
	Mar. 3, 1871	20,000
	June 10, 1872	25,000
	Mar. 3, 1873	20,000
	June 14, 1880	15,000
Total	.....	100,000

Of these amounts the following balance is yet unexpended : From the appropriation of June 14, 1880, for "improving Connecticut River between Hartford and Holyoke," $8,940.30.

Money statement.

July 1, 1890, balance unexpended	$8,940.30
July 1, 1891, balance unexpended	8,940.30

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Cargoes: Receipts by water 1,500 tons, valued at $9,000.

Vessels employed in this traffic.

	Number.	Tonnage.	Draft.
			Feet.
Steam tugs	2	2	4
Scows	4	4	4

The Enfield Canal was out of repair during 1890, and business above Hartford was confined to that below Enfield Rapids.

2. BELOW HARTFORD, CONNECTICUT.

The Connecticut River below Hartford is a large stream, for the first 21 miles flowing in a winding course, mostly through alluvial meadows which are overflowed at high water and which consist of a light sandy

soil easily undermined. For the remaining 29 miles to Long Island Sound, at Saybrook Point, the course is straighter, the banks more permanent and generally harder.

A gauge has been established at Hartford, whose zero is the lowest stage that the water is known to have reached from natural causes; closing the gates at the Holyoke Dam in time of drought has caused the water to fall lower.

The usual low-water stage of the river in the summer is about 1 foot on this gauge. Spring freshets ordinarily rise to 20 feet; the highest recorded stage of water is 29 feet.

The average tide at Saybrook is 3½ feet; at Hartford it is about 1 foot, though when the water stands above 5 feet on the Hartford gauge the tide there is not perceptible. The slope of the river from Hartford to Saybrook averages .0458 foot per mile. The bed of the river through the alluvial meadows within 10 miles of Hartford is constantly changing, from the undermining of the banks. It is said that in places it has changed its position a half mile. The bars in this part of the river, after being dredged, form again during freshets and ice jams, so that some of them require dredging annually; others, less frequently. This part of the river was worked upon by corporations and private parties at various times between 1800 and 1870. Several small stone piers, to deepen the channel at shoal places, were built in this way. Some of these are covered by new banks, the channel has shifted to the opposite side of others, and others still have been dredged out because they had come to be obstructions. The depth sought by these works was 6 feet at low water.

The following list gives the names of the several places on the river below Hartford where work has been done by the United States, with their distances by course of channel below the Hartford wagon bridge.

Locality.	Miles.	Locality.	Miles.
Hartford Bar	1½	Mouse Island Bar	20½
Clay Banks Bar	2½	Haddam Island Bar	30
Pratt Ferry, or Naubuc Bar	5½	Chester Rock	38
Press Barn Bar	6¾	Brockway Bar	41
Glastonbury Bar	9½	Calves Island Bar	44½
Dividend Bar	12	Saybrook Bar (at mouth)	50
Pistol Point Bar	15		

PROJECTS FOR IMPROVEMENT.

By act of July 4, 1836, Congress appropriated $20,000 for "improving the harbor at Saybrook, by removing the bar at the mouth of the Connecticut River." Under this appropriation a survey was made by Capt. W. H. Swift, United States Engineer Corps. In his report on this survey, dated January 31, 1837, and printed in House Ex. Doc. No. 252, Twenty-fifth Congress, Captain Swift submitted a project for deepening the west channel over Saybrook Bar, dredging a cut 500 feet wide and 12 feet deep at mean low water, at an estimated cost of $54,380.50. The estimated cost per cubic yard for dredging and dumping was 25 cents. The available depth over the bar before dredging was 7 feet at mean low water. Captain Swift's project was approved, and work was begun in May, 1838, under contract with Randall, Haskell, & Holmes, at the rate of 62½ cents per cubic yard, measured in scows. Dredging was continued until the fall of 1840, when the appropriation was ex-

hausted. Twenty-six thousand nine hundred and eighty-four cubic yards of sand and stones had been removed, making a channel 1,500 feet long, 50 feet wide, and from 11 to 12 feet deep. This channel was nearly destroyed by storms and freshets in the following winter and spring. March 1, 1843, $3,471.57 was appropriated to pay a balance due the contractors.

No further work was done upon the river until 1867. By act of Congress approved March 2, 1867, a survey of the river was ordered, which was made in the following season, and which embraced all the principal bars and obstructions between Hartford and Long Island Sound. With the report on this survey, dated January 11, 1868, and printed on page 754 *et seq.*, of the Annual Report of the Chief of Engineers for 1868, was presented a project for improving this part of the river. It proposed dredging at Hartford, Clay Banks, Pratts Ferry, Glastonbury, and Pistol Point, to make channels 8 feet deep at low water and 100 feet wide; dredging at Saybrook Bar to make a channel 8½ feet deep and 200 feet wide; piling for shore protection at Hartford and Wethersfield, and the removal of Chester Rock, at a total estimated cost of $70,000. An estimate of $10,000 for annual maintenance was submitted. All the dredging done up to 1880 was in accordance with this project, extended to make 9 to 9½ feet depth instead of 8 feet, and also to include Press Barn, Dividend, and Mouse Island Bars. The piling at Hartford was built in 1871, and the removal of Chester Rock was begun in the same year, but abandoned by the contractor soon after beginning.

January 22, 1873, a project for building three jetties at Saybrook and for dredging was approved by the Secretary of War. The jetties were to be of a double row of piles 20 feet apart, filled with stone to a height of 8 feet above low water. The dredging was to be 9 feet deep and 400 feet wide.

The estimated cost was:

Dredging	$17,850
Jetties	318,760
Total	336,610

Before work on the jetties was begun the plan of construction was modified to one for building them of riprap stone, triangular cross-section rising to level of highest water, *i. e.*, about 5 feet above mean low water, this plan being much more economical than the previous one.

The jetties were begun in 1873, and two of them were completed in 1881. The third has not been built, and may not be needed; the west jetty has since been extended, and both have been repaired and strengthened.

In 1880 a project was adopted for permanent works of improvement at six of the worst bars. (See Annual Report of the Chief of Engineers for 1880, Part I, page 396 *et seq.*)

This project provided for riprap wing dams, mattress, shore protection, and rectification of the banks at the following places, viz:

Locality.	Amount.	Locality.	Amount.
Hartford Bar	$33,464	Glastonbury Bar	$114,922
Clay Banks Bar	69,116	Dividend Bar	7,110
Pratts Ferry or Naubuc Bar	64,735		
Press Barn Bar	41,140	Total	$330,487

with dredging to make and maintain a permanent channel. The project did not provide for extension and repair of the Saybrook jetties, nor did the estimate include any amount for annual dredging to maintain channels, nor for dredging between the jetties at Saybrook, nor for any work whatever at Pistol Point, Mouse Island, Haddam Island, and Calves Island Bars, where dredging has since been required; all of these have consumed a large part of the appropriations made since.

Under this project, extended as above, up to the close of the last fiscal year, a training wall of riprap 3,689 feet long had been built at Hartford Bar (instead of the proposed wing dam), and a riprap wing dam 5,300 feet long had been built at Glastonbury Bar, both to the height of 3 feet above low water; part of the Hartford training wall was subsequently built to 4 feet above low water; the west jetty at Saybrook had been extended to the 16-foot curve, the east jetty to the 12-foot curve, and a channel 130 feet wide and 12 feet deep had been dredged between them, besides maintaining the required depth in this part of the river by annual dredging, at a cost of from $5,000 to $10,000 each year.

In 1887 it had become evident that the proposed plan of permanent improvement would not materially reduce the amount of dredging annually required, and that no effectual substitute could be recommended which would not be very expensive; and in December, 1887, a new project was adopted, under which future operations were to be confined to completing the jetties at the mouth of the river to a height of 5 feet above high water, with a top width of 6 feet, widening the channel between the jetties to 400 feet, with a depth of 12 feet at mean low water, and annual dredging to maintain the channel from Hartford to Long Island Sound, at an estimated cost as follows:

For completing jetties	$60,000
For dredging between jetties	20,000
Total	80,000
For average annual maintenance of channel from Hartford to Long Island Sound	10,000

The reasons for this change of project are fully given in a letter printed in the Annual Report of the Chief of Engineers for 1888, Part I, pages 536-538.

In 1889 a modification of this project was adopted which provides for raising the dike at Hartford to a height of 15 feet above low water at an estimated cost of $50,000, making the total estimate for completion at that time $130,000. The reasons for this modification are given in detail in letters to the Chief of Engineers of October 14 and October 24, 1889, printed in the Annual Report of the Chief of Engineers for 1890, Part I, pages 614 and 615.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By the river and harbor act of 1890, $12,500 were appropriated for this river, which according to the project were applied to annual maintenance of channels. After duly advertising proposals for hire of dredging plant were received, and under date of March 25, 1891, a contract was entered into with the Hartford Dredging Company to furnish the required plant and to operate it at a rate of excavation of not less than 72 cubic yards per hour while working in ordinary sand with a 2-foot bank, at the rate of $8.20 per actual working hour of the dredge. Work under this contract was begun May 19, and up to the close of the fiscal

year the dredge had worked 522¼ hours, removing 37,763 cubic yards of sand. Part of the time two dredges were employed. Navigable channels of 9 feet depth at mean low water were made as follows:

	Time.	Cubic yards dredged.
Hartford Bar	May 19 to 26	2,889
Glastonbury Bar	May 26 to June 8	7,318
Press Barn Bar	June 9 to 16	9,807
Hartford Bar	June 16 to 22	6,646
Clay Banks Bar	June 22 to 24	4,152
Glastonbury Bar	June 25 to 29	4,972
Dividend Bar	June 30	1,979
Total		37,763

Owing to urgent need of work at other places, it was necessary to leave Hartford and Glastonbury Bars before the channels there were completed.

PRESENT CONDITION OF IMPROVEMENT.

A depth of 9 feet at low water exists through Glastonbury and Press Barn Bars, but in very narrow channels. The other bars have depths of from 5 to 8 feet, as left by the spring freshets.

The channel between the Saybrook jetties, dredged 12 feet deep and 130 feet wide, retains nearly that depth and width.

The Hartford dike is in fair condition; the Glastonbury dike, built on a convex bank, is now nearly covered by the advance of the bank.

Both jetties at Saybrook are in fair condition. They should be built up to the dimensions provided for in the project to make them permanent.

The length of the dikes and jetties is as follows:

	Feet.
Hartford dike	3,698
Glastonbury dike	5,300
Saybrook:	
West jetty	2,550
East jetty	2,316

PROPOSED OPERATIONS.

Under the contract now in force, the 9-foot channel will be made and maintained during the current year; the Hartford dike needs slight repairs, which will be made if the funds prove sufficient after dredging.

The estimates submitted in my annual report for the year ending June 30, 1890, for the Connecticut River below Hartford were:

Amount (estimated) required for completion of existing project	$130,000
Amount (estimated) required for annual maintenance of channel	10,000

In the Annual Report of the Chief of Engineers for 1890, the estimate for completion was reduced to $117,500 by deducting the sum of $12,500 appropriated by the act of September 19, 1890. This appropriation is being applied to maintenance of channel and does not reduce the estimate for completion, viz:

Completing jetties at mouth of river	$60,000
Dredging channel between them	20,000
Raising dike at Hartford	50,000
Total	130,000

Appropriations for improvement of the Connecticut River below Hartford have been as follows :

Application.	Date.	Amount.
Dredging at Saybrook Bar	July 4, 1836	$20,000.00
Dredging at Saybrook Bar (the unexpended balance of 1836 was reappropriated)	Mar. 3, 1839	.....
Balance due contractors under previous appropriation	Mar. 1, 1843	3,471.57
Survey	Mar. 2, 1867	3,995.22
Dredging at Pratt Ferry, Pistol Point, Mouse Island; piling at Hartford	July 11, 1870	20,000.00
Dredging at Hartford, Clay Banks, Pier I, Pier J, Pratt Ferry, Glastonbury, Pistol Point, and Chester Rock	Mar. 3, 1871	35,000.00
Dredging at Pratt Ferry, Pistol Point, Saybrook Jetty	June 10, 1872	40,000.00
Dredging at Hartford, Pratt Ferry, Glastonbury, Saybrook Jetty	Mar. 3, 1873	20,000.00
Dredging at Hartford, Pratt Ferry, Saybrook, Saybrook Jetties	June 23, 1874	20,000.00
Dredging at Hartford, Pratt Ferry, Glastonbury, Saybrook Jetties	Mar. 3, 1875	20,000.00
Dredging at Hartford, Pratt Ferry, Glastonbury, Saybrook Jetties; Salmon River dredging	Aug. 14, 1876	20,000.00
Compensation for previous dredging	1878	4,203.00
Saybrook Jetties; survey from Hartford to Rocky Hill	June 18, 1878	30,000.00
Dredging at Hartford, Press Barn, Glastonbury	Mar. 3, 1879	10,000.00
Dredging at Hartford, Glastonbury, Saybrook Jetties	June 14, 1880	10,000,00
Dredging at Hartford, Pratt Ferry, Glastonbury, Glastonbury wing dam, Saybrook, Jetties	Mar. 3, 1881	30,000.00
Dredging at Hartford, Clay Banks, Pratt Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, and Salmon River, Hartford Dike	Aug. 2, 1882	45,000.00
Dredging at Hartford, Clay Banks, Pratt Ferry, Press Barn, Glastonbury, Dividend, Pistol Point, Mouse Island, and between Saybrook Jetties; extending west jetty at Saybrook	July 5, 1884	35,000.00
Dredging at Hartford, Clay Banks, Naubuc, Press Barn, Glastonbury, Dividend, Pistol Point, and Haddam Island; repair of Hartford Dike and Saybrook Jetties	Aug. 5, 1886	26,250.00
Compensations for previous dredging	Mar. 3, 1885	4,745.43
Annual dredging at Hartford, Clay Banks, Press Barn, Glastonsbury; Dividend, Brockways	Aug. 11, 1888	10,000.00
Annual dredging, in progress	Sept. 19, 1890	12,500.00
Total	.....	420,165.22

The Connecticut River is in the collection district of Hartford. By course of river the distance from Holyoke, Mass., to Hartford, Conn., is about 34 miles, and from Hartford to Long Island Sound about 50 miles. There is a light-house on Saybrook Point, on the west shore of the river, at its mouth, and another at the end of the west jetty, besides which there are three small beacon lights in the lower part of the river which are maintained by the United States.

Fort Trumbull, New London Harbor, Connecticut, about 16 miles east from Saybrook Point, is the nearest work of defense.

Money statement.

July 1, 1890, balance unexpended		$516.42
Amount appropriated by act approved September 19, 1890		12,500.00
		13,016.42
June 30, 1891, amount expended during fiscal year		1,741.75
July 1, 1891, balance unexpended		11,274.67
July 1, 1891, outstanding liabilities	$3,753.30	
July 1, 1891, amount covered by uncompleted contracts	6,787.45	
		10,540.75
July 1, 1891, balance available		733.92
Amount (estimated) required for completion of existing project		130,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		90,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for hire of dredging plant for improving Connecticut River, Connecticut, opened March 9, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per hour.	Guaranteed rate of excavation per hour.	Remarks.
			Cu. yds.	
1	Edgar M. Payn, Albany, N. Y....	$7.95	.....	No guaranteed rate. Verbal statement 50 cubic yards—*i. e.*, 15.9 cents per cubic yard.
2	J. H. Fenner, Jersey City, N. J..	9.00	68	*I. e.*, 13.24 cents per cubic yard.
3	The Hartford Dredging Company, Hartford, Conn.*	8.20	72	*I. e.*, 11.39 cents per cubic yard. Lowest bid.
4	Richard Parrott, Newburg, N. Y.	9.90	.....	No guaranteed rate. Verbal statement 50 cubic yards—*i. e.*, 19.4 cents per cubic yard.

* Lowest bid; entered into contract March 25, 1891; work in progress.

NOTE.—Amount available for contract work about $11,000.

Abstract of contract for improving Connecticut River, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date of contract.	Subject.	Price per hour.	Remarks.
The Hartford Dredging Company, Hartford, Conn..	Mar. 25, 1891	Hire of dredging plant.	$8.20	Contract in progress.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Receipts and shipments by water.

Articles.	Tons.	Value.
Coal	320,000	$1,425,000
Stone	425,000	2,000,000
Miscellaneous	350,000	52,000,000
Total	1,095,000	55,425,000

Vessels employed in this traffic.

[Draft 7 to 12 feet.]

Vessels.	Number.	Tonnage.
Owned in district:		
Steamers	15	3,500
Sailing vessels	47	5,500
Barges	29	5,500
Not owned in district:		
Vessels of all kinds	85	13,500
Total	176	28,000

No new lines of transportation have been established on this river since July 1, 1890.

The above statement shows an increase in tonnage of 25,000 tons above the amounts reported for 1889.

D 5.

IMPROVEMENT OF HARBOR OF REFUGE AT DUCK ISLAND HARBOR, CONNECTICUT.

Duck Island Harbor is a bay on the north shore of Long Island Sound, in Connecticut, between headlands known as Menunketesuck and Kelsey's Points, respectively, on the east and west sides of the harbor. It is about 7 miles west of the mouth of the Connecticut River and midway between the harbors of New Haven and New London. In this distance of 46 miles there is no secure harbor of sufficient size and depth to shelter any considerable part of the general commerce of the Sound. Duck Island Harbor has a large anchorage area with depths of 16 feet or more at low tide and with good holding bottom. It is sheltered from the north by the mainland, partly sheltered from the east by Menunketesuck Point, and slightly sheltered from the south by Duck Island, an island about 900 feet long (north and south) by 300 feet wide, situated in the mouth of the harbor rather more than half a mile west-southwest from Menunketesuck Point.

PROJECT FOR IMPROVEMENT.

Under act of Congress of August 2, 1882, a preliminary examination of this harbor was made by Col. J. W. Barlow, Corps of Engineers, the report upon which was printed in the Annual Report of the Chief of Engineers for 1884, Part I, page 684, and in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session. This report outlined two plans for improving the security of the harbor, and suggested that the adoption of a project be deferred for further consideration.

The act of Congress approved August 5, 1886, provided for a "resurvey of Duck Island Harbor on Long Island Sound, including plans, specifications, and estimates of cost for making the same a harbor of refuge." A preliminary examination, together with recent coast survey charts, afforded all the information necessary, without a detailed survey. In my report on this examination, dated November 12, 1886, and printed (with map) in the Annual Report of the Chief of Engineers for 1887, Part I, page 641, the required plans, etc., were presented. They contemplated the construction of three riprap breakwaters, one extending westerly from Duck Island, one northeasterly from the island toward Menunketesuck Point, and the third southwesterly from Menunketesuck Point. These would shelter an area of about 115 acres with 16 feet depth or more at low tide in case of southeast storms, with a larger area for storms from any other quarter. The harbor would have a broad western entrance with 17 feet depth and an eastern entrance between the breakwaters over 25 feet deep and about 750 feet wide. The breakwaters proposed were to be of riprap, 10 feet wide at top, which was to be 10 feet above low water level (about 6 feet above high water), with inside slopes of 1 upon 1 and outside slopes of 2 upon 3.

The estimated cost of riprap stone was as follows:

	Tons.
Breakwater westerly from Duck Island, 3,000 feet long	181,000
Breakwater northeasterly from Duck Island, 1,750 feet long	79,000
Breakwater southwesterly from Menunketesuck Point, 1,130 feet long	41,000
Total 301,000 tons of stone, at $1.40 per ton	$421,400
Contingencies, 10 per cent	42,140
	463,540

The beginning of work under this project was approved by the Secretary of War September 27, 1890, after the first appropriation for the harbor had been made.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $25,000 was appropriated for "Improving harbor of refuge at Duck Island Harbor, on Long Island Sound, Connecticut." After advertisement, proposals for constructing part of the west breakwater were opened, and a contract for the work was entered into with Eugene S. Belden, under date of April 21, 1891, for delivering and placing in the breakwater about 20,000 tons of riprap sandstone (Portland brown stone) at the rate of 94 cents per gross ton. Work under this contract was begun May 14, and up to the close of the fiscal year 5,126 tons of riprap had been placed in the breakwater, building 270 linear feet of the work.

In order to secure the needed shelter as rapidly as possible the breakwater is for the present made with 5 feet top width, with the top 3 feet above high water and with both side slopes 1 upon 1. Ultimately the cross-section will probably need to be enlarged to about the dimensions provided for by the project.

PRESENT CONDITION OF IMPROVEMENT.

The present condition of the breakwater is as mentioned above, the work now in progress being the only work done at this harbor.

PROBABLE OPERATIONS.

Under the existing contract the breakwater will be extended to a length of about 600 feet. Future appropriations should be applied to building the breakwaters as provided in the approved project.

The only appropriation made for improving Duck Island Harbor, Connecticut, is the one of $25,000 made by act of Congress approved September 19, 1890.

Duck Island Harbor is in the collection district of Hartford. The nearest lighthouse is at Saybrook Point, at the mouth of the Connecticut, about 8 miles eastward; there is a light vessel on Long Sand Shoal, about 5 miles to the southeast. Fort Trumbull, New London Harbor, 21 miles east, is the nearest work of defense.

Money statement.

Amount appropriated by act approved September 19, 1890		$25,000.00
June 30, 1891, amount expended during fiscal year		819.02
July 1, 1891, balance unexpended		24,180.98
July 1, 1891, outstanding liabilities	$4,918.44	
July 1, 1891, amount covered by uncompleted contracts	13,981.56	
		18,900.00
July 1, 1891, balance available		5,280.98
Amount (estimated) required for completion of existing project		438,540.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for constructing a breakwater at Duck Island Harbor, Connecticut, opened March 23, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton of 2,240 pounds for stone (18,000 tons).	Amount of bid.	Remarks.
1	John Beattie, Leetes Island, Conn.....	$1.25	$22,500	Granite.
2	Eugene S. Belden, Rocky Hill, Conn*.	0.94	16,920	Portland brown stone.
3	Brown & Fleming, New York City.....	1.10	19,800	Granite.

NOTE.—Amount available for contract work about $22,000.
* Lowest bid; entered in contract under date of April 21, 1891; contract in progress.

COMMERCIAL STATISTICS FOR CALENDAR YEAR OF 1890.

No statement of the number of vessels passing this harbor of refuge has been received.

It may be approximately estimated as 10 per cent. less than the number passing the breakwater at New Haven, where 133,740 vessels were reported as observed passing during 1890.

D 6.

IMPROVEMENT OF CLINTON HARBOR, CONNECTICUT.

Clinton Harbor is on the north shore of Long Island Sound, about 10 miles west of the mouth of the Connecticut River. It consists of an open, shallow bay and of the mouth of the Hammonasset River, as mall stream which flows easterly in front of the town wharves and empties into the bay. For three-quarters of a mile above its mouth the river is separated from the bay by a narrow strip of sand and marsh. About 1840 a breach was made through this strip half a mile above the mouth of the river which diverted a considerable part of the tidal flow, and since then two shoals have formed, one just inside the river's mouth, with 4.5 feet of water, and one out in the bay shortly before reaching deep water in the sound, with a depth of 4 feet. It is said that formerly there were depths of from 8 to 12 feet on both these bars and that shoaling occurred soon after the breach was made.

PROJECT FOR IMPROVEMENT.

By act approved March 3, 1881, Congress authorized a survey of the harbor, which was made the same year. In his report on the survey, dated January 17, 1882, and printed in the Annual Report of the Chief of Engineers for 1882, Part I, page 630, Colonel Barlow, Corps of Engineers, submitted a project for restoring the original condition of the channel by closing the breach, and by subsequently (should the increased tidal current not produce the deepening desired) dredging through the shoals, making a channel 100 feet wide and 6 feet deep at mean low water.

The cost of a dike to close the breach was estimated at $3,000, and the cost of the whole project, including the dredging, at $10,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The river and harbor act of 1890 appropriated $3,500 for continuing this improvement, and the expenditure of this sum in repairing the dike and in dredging, under open market transaction, was approved by the Chief of Engineers as being most economical and advantageous to the Government. Riprap granite was purchased at a cost of $2 per ton, delivered and placed on the dike as required. The dike was widened and built up from 1 to 2 feet higher for 262 feet of its length and was extended 16 feet over the west bank. Work was begun May 7, and the needed repairs were completed June 26, 836 tons of stone having been delivered and placed.

PRESENT CONDITION OF IMPROVEMENT.

The dike, 375 feet long, was built in 1883, using 1,574 tons of riprap granite and costing, exclusive of superintendence, $2,219.34.

In 1891 836 tons of granite were added to build up parts that had settled and to widen the base. No material change in the channel has taken place since the dike was built.

PROPOSED OPERATIONS.

With the available funds it is proposed to dredge to make the channel 6 feet deep and as wide as may be; future appropriations will be applied to completing the channel as provided for in the project.

Appropriations for improving Clinton Harbor, Connecticut, have been made as follows:

Application.	Date.	Amount.
Construction of dike	Aug. 2, 1882	$3,000
Repairs of dike	Sept. 19, 1890	3,500
Total		6,500

Clinton Harbor is in the collection district of Hartford. The nearest light-house is on Falkner Island, 8 miles southwest. Fort Hale, New Haven Harbor, 22 miles west, is the nearest work of defense.

No commercial statistics for the calendar year 1890 have been received.

Money statement.

July 1, 1890, balance unexpended		$252.73
Amount appropriated by act approved September 19, 1890		3,500.00
		3,752.73
Amount carried to the surplus fund	$252.73	
June 30, 1891, amount expended during fiscal year	134.78	
		387.51
July 1, 1891, balance unexpended		3,365.22
July 1, 1891, outstanding liabilities		2,190.00
July 1, 1891, balance available		1,175.22
Amount (estimated) required for completion of existing project		3,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		3,500.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

D 7.

IMPROVEMENT OF NEW HAVEN HARBOR, CONNECTICUT.

New Haven Harbor is a bay on the north shore of Long Island Sound, extending about 4 miles inland and from 1 to 2 miles wide. The Mill and Quinnipiac Rivers empty into the head of the harbor; they are streams of no commercial importance, except for tidal navigation at and near their mouths.

The harbor channel is from 400 feet to a mile wide, with mud and sand flats on either side. When the Government began work in this harbor, in 1867, the available low-water depth from the city wharves to Cranes Bar, about one-third way down the harbor, was 9 feet; thence to Fort Hale, which is about half way down, it was 16 feet or over; a short distance below Fort Hale was a bar of very soft mud, extending across the harbor, with 13 feet available depth at mean low water.

The entrance to the harbor was partly obstructed by several sunken rocks.

PROJECTS FOR IMPROVEMENT.

Several plans for removal of certain of the rocks at the harbor entrance have been proposed and undertaken, but not completed. The removal of the harbor light-house to Southwest Ledge and the completion of the proposed system of breakwaters will obviate the necessity for further work upon these rocks.

The work of deepening the channel in this harbor has, for the most part, been done in accordance with plans presented in annual or special reports to the Chief of Engineers, the projects being adopted under subsequent appropriations, and not based upon examinations or surveys ordered by Congress.

In a letter dated January 20, 1871, printed as House Ex. Doc. No. 95, Forty-first Congress, third session, and also on page 771 of the Annual Report of the Chief of Engineers for 1871, General Warren, U. S. Engineers, states that "the business of New Haven requires that there should be a channel dredged 200 feet wide and to a depth of 14 feet at mean low water up to the wharves," and that this is "in many respects more important to New Haven than the removal of the rocks at the entrance to the harbor." It was estimated to cost $64,815. March 3, 1871, $40,000 was appropriated for this harbor, and it was expended in the same year in making a channel 13 feet deep, 200 feet wide, up to Long Wharf, 350 feet wide at the bend at Long Wharf, and 100 feet wide from there to the steamboat wharf.

In a letter of December 23, 1871, printed in House Ex. Doc. No. 137, Forty-second Congress, first session, General Warren submitted an estimate of $26,250 for dredging 16 feet deep and 200 feet wide across Fort Hale Bar, adding that there was some doubt as to the permanence of such a channel. June 10, 1872, $15,000 was appropriated for the removal of rocks and $20,000 for harbor improvement. The former amount was expended upon Luddington Rock; the latter, with part of an appropriation of $25,000 made March 3, 1873, was expended in dredging on Fort Hale Bar, and at the close of the season of 1873 the channel had been made 16 feet deep and 200 feet wide as proposed. It soon filled to nearly its former condition. The 13-foot channel above Long Wharf was widened to 110 feet in the same year.

In the Annual Report for 1873, General Warren says "it is thought that no improvement here, beyond what can be accomplished with the

funds now available, is called for on the part of the United States, and no further appropriation is asked for."

No appropriation for this harbor was made in 1874, and none was recommended in the Annual Report of that year.

January 21, 1875, the House of Representatives, by resolution, asked "for a report from surveys already made, in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of cost of a breakwater." In a report dated January 27, 1875, Colonel Barlow, U. S. Engineers, then in charge, submitted the following estimates in reply to that part of the resolution relating to the channel (see Annual Report of the Chief of Engineers for 1875, Part II, page 250):

For channel 400 feet wide and 20 feet deep	$416,490
For channel 400 feet wide and 18 feet deep	276,990
For channel 300 feet wide and 20 feet deep	329,925
For channel 300 feet wide and 18 feet deep	208,890

Also, February 8, 1875, in reply to request from the Chief of Engineers, he estimated $10,000 as the cost of widening to 200 feet the 13-foot channel above Long Wharf, already 110 feet wide. In submitting these reports the Chief of Engineers recommended the latter work "as being of immediate importance, and whatever action may be taken upon the project of making a 20-foot channel, this at least should be done." In a subsequent report on the same matter, February 9, 1875, Colonel Barlow presented an estimate of $35,000 for widening the channel above Long Wharf to 400 feet; this was transmitted to the House of Representatives by the Secretary of War, February 13, 1875, with favorable indorsement of the Chief of Engineers. The latter plan was carried out under the appropriation of $10,000, made March 3, 1875, with a balance of about $6,000 from previous appropriations, and the 13-foot channel was made 415 feet wide above Long Wharf, the price of work being much lower than had been estimated.

Nothing was appropriated for this harbor in 1876 or 1877.

In the Annual Report for 1877, Colonel Barlow refers to the estimates submitted in his letter of January 25, 1875, and recommends that the channel below Long Wharf be made 400 feet wide and 16 feet deep, its then dimensions (200 feet wide and 13 feet deep) not affording "sufficient space for convenient navigation." The estimated cost was $40,000.

In 1878, under an appropriation of $25,000, made June 14, 1878, the channel was dredged to the length and depth proposed, with width of 300 feet.

In a letter of February 4, 1879, transmitting map of harbor examination made in December, 1878 (letter printed in the Annual Report of the Chief of Engineers for 1879, Part I, page 336), Colonel Barlow recommends deepening the channel above Long Wharf and widening the channel below, to secure 400 feet width, with 16 feet depth from the steamboat wharf down to Fort Hale; also dredging a channel 500 feet wide and 16 feet deep through Fort Hale Bar. The work above Fort Hale was estimated to cost $65,000; that below, $35,000. The proposed depth and slightly greater width above Fort Hale were obtained by October, 1881, under three successive appropriations of $15,000 each, made in 1879, 1880, and 1881. Nothing had been done on Fort Hale Bar.

In the Annual Report for 1879 a dike at Sandy Point (opposite Fort Hale) was suggested as a means of increasing the depth on Fort Hale

Bar, but on account of its expensiveness was not recommended to be undertaken until dredging had been tried again.

In the Annual Report for 1880 (Part I, page 445), Colonel Barlow renews his recommendation for dredging a channel through Fort Hale Bar, 500 feet wide and 16 feet deep.

In the Annual Report for 1881 (Part I, page 592), after current observations and borings had been made, a dike from Sandy Point is recommended, the length to be determined experimentally as construction progresses, but to be at least 4,400 feet, which length was estimated to cost $60,000.

Under appropriation of $30,000 made August 2, 1882, a plan for this dike was submitted and referred to the Board of Engineers, by whom it was slightly modified and approved October 2, 1882.

The project as approved consisted of a dike connected with Sandy Point by a shore arm about 2,160 feet long, and extending southward as a channel arm about 3,200 feet, the channel arm and part of the shore arm to be built of creosoted piling in double rows filled in with stone. In 1883 the location of the shore arm was modified upon the request of oyster-growers in the vicinity, and in 1886 the method of construction was changed to use riprap instead of creosoted piling, the latter being found more expensive both to construct and to keep in repair.

The appropriations of 1882, 1886, and nearly all of 1888, were expended upon the dike, building the shore arm and more than half of the channel arm. The appropriation of 1884 was expended in dredging under a special project for widening the channel above Long Wharf with depths of 8 and 12 feet, and for removing part of the old piers and abutements at Tomlinson Bridge, which bridge was at that time being rebuilt.

The present project for making a 16-foot channel across the Fort Hale Bar includes the completion of the dike and dredging a channel 400 feet wide and 16 feet deep through the bar. Revised estimates for completion made in 1887 (see Annual Report of the Chief of Engineers for 1887, Part I, pages 599 and 600) placed the cost of completion at that time at $46,000 for the dike and $47,000 for the channel; total $93,000. This is to be reduced by $30,000 since appropriated, making the present estimate for completion $63,000.

Up to July 1, 1890, the shore arm and 2,089 linear feet of the channel arm of the dike had been built; no dredging had been done on the Fort Hale Bar since that of 1873, but above that bar the channel has been dredged 16 feet deep at mean low water, and from 400 to 600 feet wide.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1890.

By act of Congress, approved September 19, 1890, $15,000 were appropriated for this improvement, and with approval of the Chief of Engineers it was decided to expend it in widening the 16-foot channel opposite and above Long Wharf, where it is at times almost totally blockaded by vessels at anchor awaiting opportunity to discharge. After due advertisement, proposals for such dredging were received, and under date of March 23, 1891, a contract was entered into with Charles and Henry E. Du Bois, of New York City, to dredge about 140,000 cubic yards at the rate of $9\frac{5}{10}$ cents per yard. Work under the contract was begun April 29, and the contract was completed June 26, 1891, 139,806 cubic yards of mud having been removed. The channel at the bend opposite Long Wharf was widened 230 feet, making its total width at that point 700 feet, and between Canal Dock and Sewer Dock

it was widened 140 feet, making it 540 feet wide. This affords about 10 acres additional area in the upper harbor available for vessels of deep draft while waiting to discharge freight.

PRESENT CONDITION OF IMPROVEMENT.

The available depth over Fort Hale Bar is about 13 feet at mean low water. Above this bar there is a 16-foot channel up to Tomlinson Bridge, at the head of the harbor, with from 400 to 700 feet width.

Of the Sandy Point Dike, the shore arm, 2,140 feet long, and 2,089 feet of the channel arm (including an ice-breaker 20 feet long) have been built; 1,294 feet of the inner end of the shore arm are of riprap; the outer part of the shore arm, 846 feet long, and 254 feet at the north end of the channel arm, are built of two rows of creosoted piling 8 feet apart from out to out, and filled in with stone; 1,815 feet of the channel arm south of the pile-work are built of riprap, of which the north 273 feet are on a log foundation; the ice-breaker at the north end of the channel arm is also of heavy riprap on log foundation.

PROPOSED OPERATIONS.

Future appropriations will be applied to extending the dike or to dredging in the channel, or both. The estimated cost of completing these works is $63,000, to which should be added an estimate of $5,000 annually required for maintenance of channels and repair of dike.

Appropriations for the improvement of New Haven Harbor have been made as follows:

Application.	Date.	Amount.
Removal of Middle Rock, not expended until 1867	Aug. 30, 1852	$6,000
Removal of rocks	July 11, 1870	15,000
Dredging (13 feet) above Fort Hale	Mar. 3, 1871	40,000
Dredging (16 feet) Fort Hale Bar, and removal of rocks	June 10, 1872	35,000
Dredging (16 feet) Fort Hale Bar	Mar. 3, 1873	25,000
Dredging (13 feet) above Long Wharf	Mar. 3, 1875	10,000
Dredging (16 feet) Long Wharf to Fort Hale	June 18, 1878	25,000
Dredging (16 feet) above Long Wharf	Mar. 3, 1879	15,000
Do	June 14, 1880	15,000
Dredging (16 feet) Long Wharf to Fort Hale	Mar. 3, 1881	15,000
Sandy Point Dike	Aug. 2, 1882	30,000
Dredging (18, 12, and 8 feet) above Long Wharf	July 5, 1884	10,000
Sandy Point Dike	Aug. 5, 1886	20,000
Do	Aug. 11, 1888	15,000
Dredging	Sept. 19, 1890	15,000
Total		291,000

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 3½ miles from Long Island Sound.

There is a light-house on Southwest Ledge, at the mouth of the harbor. Fort Hale, 2 miles below the city, commands the channel.

Money statement.

July 1, 1890, balance unexpended	$170.64
Amount appropriated by act approved September 19, 1890	15,000.00
	15,170.64
June 30, 1891, amount expended during fiscal year	5,332.19
July 1, 1891, balance unexpended	9,838.45
July 1, 1891, outstanding liabilities	9,120.05
July 1, 1891, balance available	718.40

Amount (estimated) required for completion of existing project.....	$63,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	63,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in New Haven Harbor, Connecticut, opened March 12, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard (140,000 cubic yards).	Amount of bid.	Remarks.
1	George B. Beardsley, Bridgeport, Conn.....	$0.13½	$18,900	
2	Thomas Potter, Jersey City, N. J	.12⅜	17,325	
3	*Charles Du Bois and Henry E. Du Bois, New York City....	.09 9/10	13,860	Lowest bid.

*Lowest bid; entered into contract March 23, 1891; contract completed June 26, 1891.

NOTE.—Amount available for contract work, about $8,000.

Abstract of contract for improving New Haven Harbor, Connecticut, in force during the fiscal year ending June 30, 1891.

Nane and address of contractor.	Date.	Subject.	Price per cubic yard.	Remarks.
Charles Du Bois and Henry E. Du Bois, New York City,	Mar. 23, 1891	Dredging .	$0.09 9/10	Contract completed June 26, 1891.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Value of imports.....	$213,812.92
Value of exports.....	1,626,225.00
Revenue receipts.....	91,024.52
Foreign vessels—entered, 22; cleared, 18; total	40
Domestic vessels—entered, 1,095; cleared, 1,109; total	2,204

Tonnage of vessels owned at this port.

	Tons.
Steamers.....	8,653
Sailing vessels.....	25,360
Barges.....	19,431
Total.....	53,444

Coastwise.

Articles.	Tons.	Value.
Coal received and shipped.....	845,000	$3,380,000
Iron received.....	115,000	2,300,000
Lumber received, 80,000,000 feet.....	120,000	2,400,000
Oysters received and shipped.....	80,000	800,000
Miscellaneous merchandise shipped	950,400	109,296,000
Miscellaneous merchandise received.....	870,000	130,500,000
Total	2,980,400	248,676,000

Vessels arriving and departing.

[Draft 6 to 20 feet.]

Steamers	25,950
Sailing vessels	18,840
Barges	11,260
Total	56,050

The above figures show an increased tonnage of freights over those reported for last year of about 705,150 tons.

No new lines of transportation have been established since the last annual report.

D 8.

CONSTRUCTION OF BREAKWATER AT NEW HAVEN, CONNECTICUT.

New Haven Harbor is the only natural harbor of any considerable area and depth in Long Island Sound, between New London Harbor, 45 miles east, and Huntington Bay, 32 miles southwest. At this point Long Island Sound is at its widest, and the broad, open mouth of the harbor left the anchorage ground exposed to storms from a southerly quarter, so that vessels driven in by stress of weather were frequently obliged to cross Fort Hale Bar, going from 2 to 4 miles up the harbor, and to anchor in the dredged channel in order to reach secure shelter.

PROJECT.

December 15, 1874, the harbor commissioners of New Haven addressed a memorial to the members of Congress from Connecticut asking that measures be taken "to procure appropriations by Congress for deepening the main ship-channel of the harbor to 20 feet, and for constructing a breakwater from the light-house (then on Five-Mile Point) to Southwest Ledge."

The memorial printed in House Ex. Doc. No. 162, Forty-third Congress, second session, stated that the breakwater contemplated would add greatly to the value of the harbor as a harbor of refuge.

January 21, 1875, a resolution was passed by the House of Representatives asking "for a report, from surveys already made, in regard to the expediency of widening and deepening the main channel of New Haven Harbor, Connecticut, to a depth not exceeding 20 feet, and also the expediency and estimate of expense of a breakwater between the eastern shore of the entrance of said harbor and Southwest Ledge, so called, or such part of said distance as may be found most expedient or necessary for the protection of said harbor." In reply to this resolution a report was made by Col. J. W. Barlow, Corps of Engineers, dated January 27, 1875, printed in House Ex. Doc., above mentioned, and also in the Annual Report of the Chief of Engineers for 1875, Part II, page 251, suggesting three locations for a breakwater, viz:

(1) That indicated in the resolution and terminating at Southwest Ledge.

(2) A line running nearly east and west, its middle point resting upon Adams Fall Rock, about one-half a mile north of Southwest Ledge,

(3) A line 400 yards further north, running nearly west from Five-Mile Point.

Estimates of cost ranging from $248,000 to $465,330 were submitted,

and with the report were also presented, letters and commercial statistics bearing upon the subject.

The question of a westerly breakwater does not appear to have been considered at that time.

This report is referred to by Colonel Barlow in the succeeding annual reports for 1876, 1877, and 1878, and in the latter year additional statistics were submitted, but no action was taken until 1879, when an appriation of $30,000 was made "for the construction of a breakwater at New Haven, Conn."

In August of the same year an examination of part of the mouth of the harbor was made, and a map transmitted to the Chief of Engineers, with several projects for breakwaters, which were referred to the Board of Engineers for report.

The report of the Board, dated November 24, 1879, and printed in the Annual Report of the Chief of Engineers for 1880, Part I, pages 449 to 452, recommended a breakwater from Southwest Ledge to Quixes Ledge, as contemplated in the resolution of the House of Representatives of January 21, 1875; but as the anchorage ground would still be exposed to southwesterly gales, the Board stated as its opinion that a breakwater extending northwest from Luddington Rock would be necessary. Their plan provided for two riprap breakwaters, 12 feet wide on top, rising 6 feet above high water, with exterior slopes of 1 on 3 and interior slopes of 2 on 3, with estimates as follows:

Estimates for breakwater from Light-house Ledge to Quixes Ledge.

Length of construction, yards	1,100
Average height of work, feet	32
Average cross-section, yards	299
Cost per cubic yard	$2.00
328,900 cubic yards, at $2	$657,800

Estimates for breakwater in the vicinity of Luddington Rock.

Length, yards	1,400
Average height, feet	28
Cross-section, square yards	233⅓
326,667 cubic yards, at $2	$653,334

This plan locates the easterly breakwater so as to lie between Light-house Ledge (or Southwest Ledge) and Quixes Ledge, and the westerly one to extend in a northwest and southeast direction, overlying Luddington Rock. The report of the Board was transmitted to the Secretary of War by the Chief of Engineers, with the suggestion that the appropriation ($30,000) be applied toward the construction of the easterly breakwaker, and was approved by him January 31, 1880. Before work had been begun, the details of cross-section were modified with the approval of the Chief of Engineers, so that the exterior slope should be 1 on 2 and the interior 1 on 1.

The first load of stone was delivered April 22, 1880, beginning the east breakwater at the end resting upon Southwest Ledge; under subsequent appropriations it was extended northeasterly, and completed to and across Quixes Ledge on February 22, 1890.

The river and harbor act of 1888 provided:

> And the Chief of Engineers may, if deemed necessary, relocate the western breakwater, and the Secretary of War is authorized, in his discretion, to expend any portion of said sum in its commencement.

An examination in reference to this matter was made in the fall of 1888, and the results reported to the Chief of Engineers in a letter

dated January 26, 1889, and printed in the Annual Report of the Chief of Engineers for 1889, Part I, page 679. In my annual report for 1889 (see Annual Report of the Chief of Engineers for 1889, Part I, page 678) I presented a modification of the project, adapted to the present and prospective requirements of commerce of Long Island Sound; this modification contemplated the relocation of the westerly breakwater, by changing its location about 6,000 feet to the southwestward, and the construction of a middle breakwater, commencing at a point 1,000 feet N. 54° E from Luddington Rock and extending S. 54° W. 5,000 feet, crossing the rock, and also a breakwater about 1,200 feet long to partly close the space between Quixes Ledge and the east shore.

The cross section of these breakwaters was intended to be the same as the one from Southwest Ledge to Quixes Ledge, viz, 12 feet wide on top, the top to be 6 feet above mean high water, with outer slope of 1 upon 2 and inner slope of 1 upon 1. It was estimated that this relocation of the western breakwater, including the intermediate breakwater across Luddington Rock, would increase the cost of completion ($941,135 in 1889) by about $750,000, and the construction of the breakwater at the east shore would add about $90,000 more.

By act of Congress approved September 19, 1890, $120,000 was appropriated for "constructing breakwater at New Haven, Conn., in accordance with the plans submitted by the Chief of Engineers in report for 1889, page 678."

The estimated cost of this project from the beginning is therefore ($1,311,134+$750,000+$90,000) $2,151,134, of which, up to July 1, 1891, $490,000 have been appropriated, and the estimated cost of completion of the project is $1,661,134.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The river and harbor act of 1890 appropriated $120,000 for "constructing breakwater at New Haven, Connecticut, in accordance with the plans submitted by the Chief of Engineers in report for 1889, page 678." After duly advertising and receiving proposals, a contract was entered into with James J. Moran, of Brooklyn, N. Y., under date of December 20, 1890, to begin construction of the breakwater crossing Luddington Rock, and to deliver and place in the work about 110,000 tons of riprap granite at the rate of $1.07 per ton.

Work under this contract was begun on top of Luddington Rock February 18, 1891, and up to the close of the fiscal year 18,019 tons of riprap had been delivered and placed, building about 350 linear feet of the work, extending N. 54° E. from Luddington Rock. In order to cover more distance and secure available shelter more rapidly, this work was built to a height of only 3 feet above high water, with a top width of 6 feet and side slopes of 1 upon 1.

PRESENT CONDITION OF WORK.

The east breakwater was completed February 22, 1890; it is 3,450 feet long, extending from the foundation of the light-house on southwest ledge northeasterly to and across Quixes Ledge, terminating in a depth of 16 feet of water at the edge of the east entrance channel. It contains 293,777 tons of riprap, and the average cost (supervision, etc., included) has been $102.50 per linear foot.

The whole work is in good condition.

The middle breakwater, crossing Luddington Rock, is as described in the preceding section.

PROPOSED OPERATIONS.

With the available funds and under the existing contract the middle breakwater will be extended northeastward and southwestward of Luddington Rock about 800 feet in each direction. Future appropriations will be applied to completing this breakwater and to carrying out the project as adopted.

Appropriations for the New Haven breakwater have been made as follows:

Application.	Date.	Amount.
Easterly breakwater	Mar. 3, 1879	$30,000
Do	June 14, 1880	30,000
Do	Mar. 3, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	40,000
Do	Aug. 5, 1886	75,000
Completing easterly breakwater	Aug. 11, 1888	75,000
Westerly breakwater	Sept. 19, 1890	120,000
Total		490,600

New Haven, the port of entry for the collection district of New Haven, is situated at the head of New Haven Harbor, about 4 miles north of the breakwater.

There is a light-house on Southwest Ledge, the west terminus of the east breakwater.

Fort Hale, 2 miles north of the breakwater, commands the harbor channel.

Money statement.

July 1, 1890, balance unexpended		$15,670.48
Amount appropriated by act approved September 19, 1890		120,000.00
		135,670.48
June 30, 1891, amount expended during fiscal year		14,756.42
July 1, 1891, balance unexpended		119,914.06
July 1, 1891, outstanding liabilities	$8,508.87	
July 1, 1891, amount covered by uncompleted contracts	99,722.60	
		108,231.47
July 1, 1891, balance available		11,682.59
Amount (estimated) required for completion of existing project		1,661,134.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for constructing a breakwater at New Haven, Conn., opened at Engineer Office, U. S. Army, New York City, December 2, 1890.

No.	Name and address of bidder.	Rate per ton of 2,240 pounds for stone. (100,000 tons).	Number of months required to do the work.	Amount of bid.	Remarks.
1	William T. Gaynor, Fayetteville, N.Y.	$1.13	15 months	$113,000	Granite.
2	S. & E. S. Belden, Hartford and Rocky Hill, Conn	1.19 1.17	20 months from March 1, 1891.	119,000 117,000	Granite. Brownstone.
3	Joseph P. Stanton, New York City	1.19	15 months	119,000	Granite.
4	John Beattie, Leetes Island, Conn.	1.43	15 months	143,000	Granite.
5	Andrew D. Baird, Brooklyn, N. Y.	1.21	20 months,	121,000	Granite.
6	John A. Bouker, New York City	1.30		130,000	Kind of stone not stated.
7	Francis H. Smith, New York, City	1.44	20 months	144,000	Granite and gneiss.
8	*James J. Moran, Brooklyn, N. Y	1.07	16 months	107,000	Granite. Lowest bid.
9	Brown & Fleming, New York City	1.16	18 months	116,000	Granite.

*Entered into contract December 20, 1890; in progress.

Abstract of contract for construction of a breakwater at New Haven, Conn., in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per ton.	Remarks.
James J. Moran, Brooklyn, N. Y.	Dec. 20, 1890..	Constructing breakwater crossing Luddington Rock, delivering and placing rip-rap granite.	$1.07	In progress.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Vessels passing New Haven Breakwater.

Vessels.	No.	Vessels.	No.
Men-of-war	30	Schooners and sloops	56,020
Steamships	2,400	Barges in tow	33,000
Steamers of all kinds	40,950		
Ships, barks, and brigs	1,340	Total	133,740

This is 3,000 more vessels than reported for the previous year. In neither case are the records complete, as many vessels pass unobserved in night or in thick weather. The value of this commerce can not be ascertained.

D 9.

IMPROVEMENT OF MILFORD HARBOR, CONNECTICUT.

This harbor is on the north shore of Long Island Sound, about 9 miles southwest of New Haven, Conn. It consists of a broad, open bay, from the head of which the Wepauwog River, a small tidal stream, extends three-quarters of a mile north to the Milford Wharves, and the Indian River, another small inlet, extends northeasterly. The mouth of the latter stream is partly closed by a dam formerly used to create power for a tide-mill.

The original depth on the bar just outside the mouth of the rivers was less than 2 feet at mean low water, and in some places between there and the upper wharves low tide left the channels nearly bare.

The mean rise of tide is 6.2 feet.

PROJECTS FOR IMPROVEMENT.

A survey of breakwater at Milford, Conn., was ordered by Congress in the river and harbor act of 1872. There being no breakwater, a survey of the harbor was made for a breakwater, and in his report, dated December 24, 1874 (printed as part of Ex. Doc. No. 107, Forty-second Congress, third session, and also on page 1041 of the Annual Report of the Chief of Engineers for 1873), General Warren, U. S. Engineers, submitted the following plan of improvement:

1. A riprap breakwater from Welch's Point, on the east side of the mouth of the harbor	$67,000
2. Protecting the bluffs on the east shore from erosion by means of small stone jetties	5,500
3. Dredging 4 feet deep and 100 feet wide across the bar at the mouth of the river	6,250
4. A jetty on the east side of the channel to prevent the dredged area from filling and to confine the action of the tide	5,000
Superintendence	1,250
Total	85,000

In 1874 $5,000 was appropriated for this harbor and work under the above project was begun, building the small jetties to protect the east shore. Twelve such jetties were built, 100 to 130 feet long, and rising to 9 feet above mean low water. The appropriation of 1875 ($13,000) was applied to the repair of these jetties, to construction of a jetty from the east shore, at the mouth of Indian River (Long Jetty), and to dredging across the bar.

In the Annual Report for 1876 (see Annual Report of the Chief of Engineers for 1876, Part I, page 225), Colonel Barlow, U. S. Engineers, recommended that the dredged channel be carried up to Town Wharf, about a half mile farther, at an additional estimated cost of $9,000.

This recommendation was renewed in 1877, and was included in the project for expenditure of the appropriation of $10,000 made in 1878. In that and the following year the 4-foot channel across the bar was completed to 100 feet width, as originally projected, and was extended to Town Wharf with width from 60 to 75 feet, and Long Jetty was repaired; also, under the same appropriation, in 1879 and 1880, an additional jetty, authorized by Department letter of October 16, 1889, was built on the west side of the channel, extending southward from Burns Point. This appropriation completed the original project except the breakwater. Sufficient money for beginning that had not been appropriated.

June 14, 1880, $5,000 was appropriated, and in accordance with a project for its expenditure submitted and approved, the 4-foot harbor channel was extended from Town Wharf to the Straw Works Wharf, at the upper end of the harbor, with a width of 40 feet. This was completed before the appropriation was exhausted, and "at the earnest solicitation of those most interested in the works of improvement there, an experimental channel, 25 feet wide and 8 feet deep, was cut through the bar at the entrance, lying within and on the west side of the channel already made. This is now of great use to the steam vessels employed in the fish-oil works at that place, and it is claimed that the increase of shipping in the harbor, particularly in the oyster business, for which those waters seem very well adapted, will soon require an 8-foot channel of fully 100 feet width. Such a channel would involve the removal of about 45,000 cubic yards more of material, principally sand and gravel, which, at ruling prices, would cost, including superintendence and incidental expenses, about $11,000." (Extract from Colonel Barlow's annual report for 1881; see Annual Report of the Chief of Engineers for 1881, Part I, pages 598 and 599.)

Under the appropriation of $5,000, made August 2, 1882, the project above suggested was adopted and the 8-foot channel was widened to 65 feet from the bay up to Merwin's Wharf, with 100 feet width around the bend at Burns Point. In 1889 this channel was made fully 100 feet wide, and some needed repairs to Long Jetty were begun.

By act of Congress approved March 3, 1881, a survey for a breakwater and harbor of refuge at Milford Harbor was authorized. The survey was made, and a report, with estimates, was submitted January 20, 1882. This report is printed in the Annual Report of the Chief of Engineers for 1882, Part I, page 632.

Under date of December 14, 1889, Hon. O. H. Platt, United States Senate, wrote the Chief of Engineers requesting an examination of Milford Harbor and a report upon dredging the channel to the upper wharves. This report was made December 31, 1889. In compliance with a resolution of the House of Representatives of January 18, 1889, a copy of the report was transmitted to the House, and printed as House Ex. Doc. No. 139, Fifty-first Congress, first session; also in the Annual Report of the Chief of Engineers for 1890, Part I, page 629.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $2,500 were appropriated for this improvement. This was the amount estimated in previous annual reports as required for repairs of the jetties, and with approval of the Chief of Engineers granite was purchased in open market (that method being most economical and advantageous to the Government) to be used in widening the base of Long Jetty, at the mouth of Indian River; the price is $2.50 per gross ton, delivered and placed. Work was begun June 11, 1890, and is still in progress; up to the close of the fiscal year 170 tons of stone had been delivered and placed, repairing about 160 linear feet of Long Jetty.

PRESENT CONDITION OF IMPROVEMENT.

The channel, dredged 4 feet deep, with width of 60 feet for about two-thirds the distance from the mouth of the river to the Straw Works Wharf, and width of 40 feet for the rest of the distance, has shoaled somewhat.

The channel across the bar is now 8 feet deep and over 100 feet wide.

Repairs of Long Jetty, on the east bank, at the mouth of Indian River, are in progress.

PROPOSED OPERATIONS.

The project is completed, and nothing further is contemplated under it except what is from time to time necessary for maintenance of the jetties and dredged channels.

No appropriation is needed for the ensuing year.

Appropriations for Milford Harbor have been made as follows:

Application.	Date.	Amonnt.
Survey	June 10, 1872	$1,500
Jetties on east shore	June 23, 1874	5,000
Long Jetty and dredging at mouth of river	Mar. 3, 1875	13,000
Dredging to Town Wharf	June 18, 1878	10,000
Dredging above Town Wharf and (8 feet) below Merwin's Wharf, on bar	Jnne 14, 1880	5,000
Survey for breakwater	Mar. 3, 1881	100
Dredging 8 feet on bar	Aug, 2, 1882	5,000
Dredging 8 feet on bar and repairing Long Jetty	Aug. 11, 1888	5,000
Repairing jetties	Sept. 19, 1890	2,500
Total		**47,100**

Milford Harbor is in the collection district of New Haven; it is about 9 miles west from Fort Hale, New Haven Harbor. The nearest light-house is on Stratford Point, 4 miles to the westward.

Money statement.

July 1, 1890, balance unexpended	$71.95
Amount appropriated by act approved September 19, 1890	2,500.00
July 1, 1891, balance unexpended	2,571.95
July 1, 1891, outstanding liabilities	491.67
July 1, 1891, balance available	**2,080.28**

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Vessels arriving and departing.

[Draft 3 to 12 feet.]

Kind.	Number.	Tonnage.
Steamers	2,340	140,400
Sailing vessels	625	30,250
Barges	8	2,400
Total	2,973	173,050

The chief articles of commerce are—

Coal received 2,000 tons	$9,000
Lumber received	5,000
Oysters received and shipped 150,000 bushels	120,000
General merchandise, including fish oil and fertilizers from Welch Point	30,000
Total	164,000

The above figures amount in aggregate to about 12,000 tons, being an increase of 1,000 tons over amounts reported for 1889. Most of the coal, lumber, and general merchandise are now transported by rail.

No new lines of transportation have been established during the year.

D 10.

IMPROVEMENT OF HOUSATONIC RIVER, CONNECTICUT.

The Housatonic is a long shallow river, running southward through Massachusetts and Connecticut, and emptying into Long Island Sound just east of Stratford Point, about 15 miles southwest from New Haven. At Derby, 13 miles above its mouth, it receives the discharge of the Naugatuck, a small rapid river. This point, which has been regarded as the head of navigation, is nearly the head of tide water. About a mile above there is a dam across the Housatonic River furnishing large water-power. For at least 5 miles below Derby the water is always fresh.

The original depth on the worst bars in the river (6 in number) was from 3.5 to 4.5 feet at mean low water; there was also a bar across the river's mouth with about 4 feet low-water depth.

PROJECTS FOR IMPROVEMENT.

In pursuance of a resolution of the House of Representatives, dated December 20, 1869, authorizing a survey of the Housatonic River below Derby, which resolution was referred by the Secretary of War to the Chief of Engineers for report as to the "necessity for the survey," an examination of the river from Derby to Long Island Sound was made by Col. D. C. Houston, Corps of Engineers, who reported January 8, 1870, and recommended a detailed survey of all that part of the river at an estimated cost of $5,000. This report was printed in House Ex. Doc. No. 62, Forty-first Congress, second session.

By act of Congress approved July 11, 1870, a survey of Housatonic River below Derby, Conn., was directed, and an allotment of $2,700

was made for a survey "sufficient to determine the prominent obstructions to navigation." In his report on this survey, dated January 23, 1871, and printed in House Ex. Doc. No. 95, Forty-first Congress, third session, also in the Annual Report for 1871, page 781, Gen. G. K. Warren, Corps of Engineers, submitted the following estimates for making a channel 7 feet deep at mean low water, to be 200 feet wide over the bar at the mouth of the river and 150 feet wide in the river, the channel at the river's mouth to be protected on the east side by a breakwater from Milford Beach.

Jetty at Sow and Pigs Reef	$4,000
Removing Drew Rock, 357 cubic yards	2,000
Dredging inside the bar at the mouth	18,486
Dredging on the bar at the mouth	12,000
Construction of breakwater at mouth	368,475
Total	404,961

The breakwater was to be built of riprap up to 1½ feet above mean low water and of dimension stone above; it was to be 6 feet wide on top, rising to 11 feet above low water, and was to extend to the 6-foot curve, an estimated length of 4,200 feet.

March 3, 1871, the first appropriation for improvement of the river was made and work in accordance with the project was begun. In 1872 the project was modified to admit of a jetty connecting Drew Rock with the west bank, instead of removal of the rock. This was done on the ground of economy and the jetty was built in 1872. The result has been to form a bar below the jetty, which required such frequent dredging that it was found expedient to remove the rock as originally projected. This was done in 1887–'88.

Appropriations were not made in sufficient amount to warrant beginning the breakwater as originally designed, and in 1879 Colonel Barlow proposed to substitute for it a riprap jetty, at an estimated cost of $12,000. In 1882 the estimate was changed to $20,250, the contemplated jetty being 6,000 feet long and rising only to low-water level. Such a jetty could subsequently be built higher, if necessary, and there seems no doubt that this would have to be done before any useful effect could be realized. Therefore, in my annual report for 1887 (see Annual Report of the Chief of Engineers for 1887, Part I, page 607), I presented revised estimates for a breakwater, modifying the originally proposed method of construction to one for using riprap only, experience at harbors on Long Island Sound having shown this construction to be as durable as dimension work and more economical.

At the same time estimates based on recent surveys were submitted for the dredging necessary to make the channel 7 feet deep, with width of 200 feet at the mouth of the river and 100 feet above. The latter width was adopted in 1883, because, up to that time, the originally proposed width of 150 feet had never been obtained.

Following are the estimates for the breakwater and for dredging submitted in 1887:

For a breakwater 5,750 feet long, extending from Milford Beach 3,250 feet in a course about south-southeast, thence parallel with and 500 feet from the channel 2,500 feet farther to the 12-foot curve; inside the bend to be built up to 3 feet above mean low water, top width 6 feet, side slopes 1 on 1; outside the bend to be built up to 6 feet above high water, top width 12 feet, outer slope 1 on 2 and inner slope 1 on 1	$175,000
For dredging at the mouth of the river and at 6 bars in the river, 146,000 cubic yards, at 16 cents, with about 15 per cent. added for contingent expenses	27,000
Total	202,000

To which should be added about $4,000 annually required for maintenance of channels.

January 27, 1888, a letter further explaining the reasons for the new estimate for breakwater was submitted to the Chief of Engineers, and was subsequently printed as Senate Ex. Doc. No. 103, Fiftieth Congress, first session, and also in the Annual Report of the Chief of Engineers for 1888, Part I, page 554.

The breakwater was begun July 10, 1889, and up to July 1, 1890, 1,200 linear feet of work had been built, extending south-southeast from above high-water mark on Milford Beach, using 5,063 tons of riprap.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The contract with William H. Morton for construction of breakwater, which was in progress at the beginning of the fiscal year, was completed December 29, 1890; the amount of stone delivered during the year was 7,443 tons, and the length of breakwater built was 2,090 feet, 40 feet of which was outside the bend and was built to a height of 4 feet above high water, with top width of 5 feet and slopes of 1 upon 1. The total length of work built under this contract was 3,290 feet, and 12,506 tons of riprap were used.

By act of Congress approved September 19, 1890, $35,000 were appropriated for improvement of this river. After advertising, proposals were received for extending the breakwater and for hire of dredging plant for deepening the bars in the river. A contract, dated December 23, 1890, was entered into with Brown & Fleming, of New York City, to furnish and place in the breakwater 20,000 tons, more or less, of riprap granite, at the rate of $1.33 per ton. The contractors represented that they found themselves unable to obtain riprap granite in sufficient quantities to make the required progress and to complete their work within the time specified, and at their request supplementary articles of agreement are being now prepared to admit of the use of New York City stone (gneiss) in lieu of granite, at the rate of $1.23 per ton. No stone has yet been delivered under the contract.

A contract, dated March 23, 1891, was entered into with Richard Parrott, of Newburg, N. Y., for furnishing a dredging plant and operating it at a rate of excavation of not less than 50 cubic yards per hour while working in ordinary sand with a 2-foot bank, the rate of payment to be $16 per actual working hour of the dredge. Mr. Parrott began work June 15, and up to the close of the fiscal year had worked $45\frac{30}{60}$ hours, removing 2,176 cubic yards from the bar at Shelton, near the head of river navigation, making a channel 7 feet deep partly through the bar. Dredging is now in progress.

During the past winter and spring the currents have undermined parts of the breakwater, cutting gullies of about 6 feet depth through them. This requires prompt repair, and, as the existing contract with Brown & Fleming provides only for extension of the breakwater, with the authority of the Chief of Engineers an arrangement has been made for purchase of stone in open market under emergency, to repair the work as needed. Stone is now loading for delivery under this arrangement.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 3,290 feet long and contains 12,506 tons of stone; for 3,250 feet it is built up to half-tide level; the outer 40 feet are 4 feet above high water, with top width of 5 feet. Its condition is good, except the injuries above mentioned.

The channel shoaled materially in places during the past winter, and the present depth on the bars is from 4 to 5 feet at mean low water. On the outer bar the depth is 7 feet, but the channel has shifted westward slightly since last dredged.

PROPOSED OPERATIONS.

Under contracts now in force the breakwater will be extended southeastward about 1,000 feet, and the channels over the river bars will be deepened; the gaps in the breakwater will also be repaired.

The estimated cost of completing this improvement is $132,000, to which should be added about $4,000 annually for maintenance of channels and for repairs.

Appropriations for the Housatonic River have been made as follows:

Application.	Date.	Amount.
Examination	Mar. 2, 1867	$42
Survey	July 11, 1870	2,700
Sow and Pigs jetty, dredging	Mar. 3, 1871	15,000
Drew Rock jetty, dredging	June 10, 1872	15,000
Dredging	Mar. 3, 1873	10,000
Do	June 23, 1874	10,000
Do	Mar. 3, 1875	5,000
Do	June 18, 1878	5,000
Do	June 14, 1880	2,000
Do	Mar. 3, 1881	2,000
Removing Drew Rock and jetty in 1887	Aug. 2, 1882	2,000
Do	July 5, 1884	2,500
Do	Aug. 5, 1886	5,000
Commencing breakwater, dredging	Aug. 11, 1888	35,000
Extending breakwater, dredging	Sept. 19, 1890	35,000
Total		146,242

The Housatonic River is the boundary between the collection districts of New Haven and Fairfield. The nearest work of defense is Fort Hale, New Haven Harbor, about 15 miles east. The nearest light-house is on Stratford Point, at the mouth of the river.

Money statement.

July 1, 1890, balance unexpended		$21,428.01
Amount appropriated by act approved September 19, 1890		35,000.00
		56,428.01
June 30, 1891, amount expended during fiscal year		16,231.55
July 1, 1891, balance unexpended		40,196.46
July 1, 1891, outstanding liabilities	$898.47	
July 1, 1891, amount covered by uncompleted contracts	32,876.53	
		33,775.00
July 1, 1891, balance available		6,421.46
Amount (estimated) required for completion of existing project		132,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		100,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for extension of breakwater at mouth of the Housatonic River, Connecticut, opened December 15, 1890, by Col. D. C. Houston, Corps of Engineers.

No	Name and address of bidder.	Rate per ton of 2,240 pounds for stone (20,000 tons).	Number of months required to do the work.	Amount of bid.	Remarks.
1	John Beattie, Leetes Island, Conn.	$1.45	12	$29,000	Granite.
2	S. & E. S. Belden, Rocky Hill, Conn.	1.41	8	28,200	Brown stone.
3	John A. Bouker, New York City.	2.00	12	40,000	Kind of stone not stated.
4	*Brown & Fleming, New York City.	1.33	12	26,600	Granite; Connecticut River; lowest bid.
5	Francis H. Smith, New York City.	1.59	10	31,800	Granite or gneiss.
6	William H. Morton, New York City.	2.36	16	47,200	Stone; Housatonic River.

*Lowest bid. Entered into contract December 23, 1890; work not yet begun.

NOTE.—Amount available for contract work, about $24,000.

Abstract of proposals for hire of dredging plant for improving Housatonic River, Connecticut, opened March 9, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per hour.	Guaranteed rate of excavation per hour.	Remarks.
1	Thomas Anderson, Stratford, Conn	$17.00	.....	No guaranteed rate.
2	*Richard Parrott, Newburg, N. Y	16.00	.....	Lowest bid. Verbal statement: 50 cubic yards, *i. e.*, 32 cents per cubic yard.

*Lowest bid. Entered into contract March 23, 1891; work in progress.

NOTE.—Amount available for contract work, about $7,000.

Abstract of contracts for improving Housatonic River, Connecticut, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date of contract.	Subject of contract.	Rate of payment.	Remarks.
William H. Morton, New York City.	May 17, 1889	Delivery of riprap granite and construction of breakwater.	$1.49 per ton...	Completed Dec. 29, 1890.
Brown & Fleming, New York City.	Dec. 23, 1890	....do	$1.33 per ton...	Not yet begun; expires January 16, 1892.
Richard Parrott, Newburg, N. Y.	Mar. 23, 1891	Hire of dredging plant.	$16 per actual working hour of dredge.	In progress.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

At Derby and Shelton, head of navigation.

Vessels arriving and departing.	Number.	Tonnage.
Steamers	170	19,500
Barges	136	14,650
Sailing vessels	48	12,750
Total	354	46,900

Freight received and shipped.	Tons.	Value.
Lumber, 3,050,000 feet	4,850	$62,301
Coal	15,645	72,430
Paper	29,000	12,500
Iron	1,200	23,000
Miscellaneous received	16,905	21,062
Miscellaneous shipped	200	16,000
Total	67,800	207,293

At Stratford, near mouth of river.

Vessels arriving and departing.	Number.	Tonnage.
Large vessels :		
Steamers	2,000	120,000
Sailing vessels	720	42,200
Barges in tow	50	15,000
Small vessels :		
Oystermen (sail vessels)	12,000	37,800
Total	14,770	215,000

Freights received and shipped.	Tons.	Value.
Coal	16,000	$80,000
Oysters	5,000	125,000
Oyster shells	18,000	54,000
Miscellaneous merchandise	32,000	640,000
Total	71,000	899,000

The total tonnage of river freights for 1890, as above reported, is 138,800, being less than that reported for 1889 by 166,170 tons.

No new lines of transportation have been established upon this river since the last annual report.

D 11.

IMPROVEMENT OF BRIDGEPORT HARBOR, CONNECTICUT.

This harbor extends nearly 3 miles inland from the north shore of Long Island Sound, its width of about 1 mile at the mouth decreasing to 200 feet between opposite wharves at its upper end. The channel, even in the widest part of the harbor, is comparatively narrow.

Before the first work by the United States was done at this harbor the depth over the bars, at the harbor's mouth, was about 5 feet at low water, equivalent to 11½ feet at high water, and the low-water depth above the bridges was from 2 to 7 feet.

PROJECTS FOR IMPROVEMENT.

In 1833 a petition of the citizens of Bridgeport was presented to Congress asking an appropriation of $10,000 to improve the harbor. This was granted in 1836, and the agent in charge was instructed by the Engineer Department to dredge a channel 8 feet deep, making it 200 feet wide through the outer bar and 100 feet wide through the inner bar, or as much as the appropriation would admit of. The work was done by contract, in 1837. The rate was high (understood to be 72.8 cents per cubic yard), and the funds were exhausted when the channel through the outer bar had been made 60 feet wide.

In 1838 Captain Swift, U. S. Engineers, reported that the channel had been sounded and was found to be 12 feet deep, or 4 feet deeper than when left by the dredger.

Nothing further was done until 1852, when a second appropriation of $10,000 was made. Captain Dutton, U. S. Engineers, found that the channel on the outer bar was then 6 feet deep and 90 feet wide, and on the inner bar but 5 feet deep, and he submitted a project for dredging through both bars to a depth of 8 feet and a width of 200 feet, at a total estimated cost of $32,000. This project was approved by the Secretary of War, February 5, 1853, and with the $10,000 then available channels 8 to 13 feet deep were dredged 100 feet wide through the inner bar and 60 feet wide through the outer bar.

By act of Congress approved June 23, 1866, a survey of the harbor was ordered, which was made in that year. The object of the survey was to ascertain "the present state of the harbor and the character and extent of the encroachments upon it by the action of the tides," it being feared that Long Beach, on the east side of the harbor's mouth, was making northwestward by reason of sand drifting along the shore in such a way as to contract and ultimately fill up the channel above the inner bar. This work was at that time in my charge, and in my report on the survey, dated January 12, 1867, I stated that it had been proposed to construct a breakwater, extending out from Long Beach, to arrest the sand, but the danger feared did not seem imminent, and I recommended a series of observations for the purpose of ascertaining the nature and amount of changes taking place.

In 1867 a survey of the shore line of Long Beach was made.

In 1868 I was directed by the Chief of Engineers to make "such resurvey of Bridgeport Harbor, Connecticut, as may be found necessary to ascertain what changes have occurred since the survey of 1866." In my report on this survey I said that the channel remained the same, and that no appropriation was needed until "the channel is found to be inadequate to the necessities of commerce, and then dredging must be resorted to."

In 1870 a petition of citizens of Bridgeport was presented to Congress asking that an appropriation "be made to remove said sand bar" (the outer bar) "and to widen and deepen said channel and harbor in order that vessels drawing 12 feet of water may be enabled to enter without being grounded and without the aid of lighters," and a survey or examination of the harbor was ordered.

The work was then in charge of General Warren, U. S. Engineers. He made an examination of the harbor and found it unnecessary to make further surveys. In his report dated January 12, 1871, General Warren submitted a project for dredging a channel 100 feet wide and 12 feet deep at extreme low water (or 14 feet at mean low water), and for build-

ing a pier 3,000 feet long, extending out from Long Beach, to be partly of riprap, partly of dolphins. The estimated cost of the project was $124,000. After an appropriation of $20,000 was made, in 1871, work under this project was begun, dredging to depths of 12 and 13 feet at mean low water and substituting a riprap jetty for riprap and dolphins. The jetty was completed as far as deemed necessary in 1873.

In 1875 the dimensions of the projected channel were modified so as to make it 12 feet deep at mean low water and from 200 to 300 feet wide. This was accomplished in 1882.

In 1878, in compliance with the terms of the appropriation act of that year, a channel 100 feet wide and 9 feet deep was dredged from the lower bridge to the horse railroad bridge, a distance of about 3,000 feet.

After the appropriation of 1882 a project for widening to 600 feet the channel between the inner beacon and the Naugatuck Railroad Wharf was adopted to prevent overcrowding of the main channel by vessels entering to seek refuge during storms. The estimated cost was $60,000. This is nearly completed, a small area near the inner beacon remaining to be dredged.

In November, 1887, a petition was sent to the Secretary of War, signed by the mayor and other citizens of Bridgeport, asking that $10,000 be appropriated for a channel 8½ to 9 feet deep and 100 feet wide above the horse railroad bridge. This petition, with indorsements and report estimating $18,000 as the cost of such work, is printed in the Annual Report of the Chief of Engineers for 1889, Part I, pages 697–699. The appropriation act of 1888 authorized this work, and the project was therefore extended to include it.

March 8, 1889, a petition was addressed to the Secretary of War by the mayor and other citizens of Bridgeport, representing the necessity of a breakwater within the harbor of Bridgeport. This petition, with indorsements, is printed in the annual report of the Chief of Engineers for 1889, Part I, pages 700–702. The indorsements estimate the cost of a breakwater from the Tongue to the inner beacon at about $30,000, and authorize the extension of the project to include this work.

The project for improving this harbor as thus extended consists—

First. In dredging, to make and maintain a channel 12 feet deep at mean low water and 300 feet wide or more, from Long Island Sound to the lower bridge, nearly completed. Estimated cost to complete, $17,000.

Second. In dredging, to make and maintain a channel 9 feet deep and 100 feet wide from the lower bridge to the head of the harbor, partly completed. Estimated cost to complete, $3,000 in addition to funds now available.

Third. In building a breakwater from the Tongue to the inner beacon just begun; estimated to cost $30,000, of which $15,000 has been appropriated.

It is probable that ultimately an extension of the east breakwater will be required.

Up to July 1, 1890, 45,000 cubic yards had heen dredged above the horse railroad bridge, making a channel 1,800 feet long, 9 feet deep, and 75 to 90 feet wide, up to within 100 feet of Blacks Wharf.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $20,000 were appropriated for this improvement, with the proviso that "$15,000 shall

be expended in constructing breakwater between the Tongue and inner beacon, and $5,000 to complete improvement above the bridge.

In accordance with these requirements, after due advertisement, proposals for construction of breakwater between the Tongue and the inner beacon were opened January 15, 1891, and under date of January 26, 1891, a contract was entered into with Messrs. Brown & Fleming, of New York City, to deliver about 10,000 tons of riprap granite and build the breakwater at the rate of $1.29 per ton of riprap.

Delivery of stone under this contract was begun June 27, 1891, and is in progress. Up to the close of the fiscal year 750 tons of riprap had been placed, and 300 linear feet of the breakwater partly completed.

Proposals for dredging above the bridges were opened February 10, and under date of February 27, 1891, a contract was entered into with Mr. George B. Beardsley, of Bridgeport, Conn., to dredge about 26,000 cubic yards, at the rate of 14.6 cents per cubic yard; dredging has not yet been begun. This work is part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk, and the time of commencement specified was on or before August 1, 1891.

PRESENT CONDITION OF IMPROVEMENT.

The 12-foot channel is 75 feet wide on the outer bar, but for 200 feet width there is a depth of 11 feet or over; thence across the inner bar and up to the inner beacon the 12-foot channel is about 300 feet wide; thence up to the Naugatuck Railroad Wharf it is 600 feet wide; from that wharf to the lower bridge it has shoaled so that the present depth is from 10 to 11 feet.

The channel from the lower bridge to the horse-railroad bridge, dredged 9 feet deep and 100 feet wide in 1878, retains nearly that depth and width; the 9-foot channel above the horse-railroad bridge is 1,400 feet long and from 75 to 90 feet wide.

The breakwater at Long Beach has settled since it was built in 1871–'73; it still serves the purpose for which it was designed, and no repairs are now needed.

The project of 1882 for making 600 feet width of channel between the inner beacon and the Naugatuck Railroad Wharf was reported completed in 1887; the inner beacon has since been rebuilt and its location slightly changed, which makes it desirable to cut off a short point outside the new position of that beacon; this was partly done in 1888.

The breakwater from the Tongue to the inner beacon has been begun.

PROPOSED OPERATIONS.

With future appropriations it is proposed to complete the channel above the bridges, to remove the shoal places above the Naugatuck Railroad Wharf, and to widen the channel eastward to the harbor line, an additional width of about 200 feet; also to complete the breakwater from the Tongue to the inner beacon. The estimated cost of the above work is $35,000; it could be done to advantage in a single year.

The annual cost of maintaining the dredged channels in this harbor is estimated at $3,000.

Appropriations for the improvement of Bridgeport Harbor have been made as follows :

Application.	Date.	Amount.
Dredging outer bar	July 4, 1836	$10,000.00
Dredging outer and inner bars	Aug. 30, 1852	10,000.00
Survey	June 23, 1866	1,985.38
Do	July 11, 1870	500.00
Dredging and 521 feet of breakwater	Mar. 3, 1871	20,000.00
Dredging and 859 feet of breakwater	June 10, 1872	40,000.00
Dredging inner bar and upper harbor	Mar. 3, 1873	30,000.00
Dredging bridge to Long Island Sound (9 feet)	June 23, 1874	20,000.00
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1875	15,000.00
Dredging upper harbor (9 feet)	Aug. 14, 1876	10,000.00
Dredging above bridge and outer bar (9 and 12 feet)	June 18, 1878	10,000.00
Dredging bridge to Long Island Sound (12 feet)	Mar. 3, 1879	10,000.00
Do	June 14, 1880	10,000.00
Dredging above inner beacon (12 feet)	Mar. 3, 1881	10,000.00
Dredging beteen inner beacon and railroad wharf (12 feet)	Aug. 2, 1882	10,000.00
Do	July 5, 1884	5,000.00
Do	Aug. 5, 1886	20,000.00
Dredging above horse-railroad bridge (9 feet)	Aug. 11, 1888	10,000.00
Dredging and breakwater at Tongue	Sept. 19, 1890	20,000.00
Total		262,485.38

Bridgeport, the port of entry for the collection district of Fairfield, is situated about 2 miles from Long Island Sound, at the head of Bridgeport Harbor. There is a lighthouse at the entrance to the harbor. Fort Hale, New Haven Harbor, the nearest work of defense, is 18 miles east.

Money statement.

July 1, 1890, balance unexpended		$1,328.75
Amount appropriated by act approved September 19, 1890		20,000.00
		21,328.75
June 30, 1891, amount expended during fiscal year		1,427.40
July 1, 1891, balance unexpended		19,901.35
July 1, 1891, outstanding liabilities	$1,067.50	
July 1, 1891, amount covered by uncompleted contracts	15,728.50	
		16,796.00
July 1, 1891, balance available		3,105.35
Amount (estimated) required for completion of existing project		35,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		35,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for construction of a breakwater at Bridgeport, Conn., opened January 15, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Price per ton for stone (10,000 tons).	Time for completion.	Amount of bid.	Remarks.
1	John Beattie, Leetes Island, Conn	$1.30	6 months	$13,000	Granite.
2	Humphrey Toomey, Guilford, Conn	1.50	9 months	15,000	Do.
3	Thomas Anderson, Stratford, Conn	2.17	12 months	21,700	Stone according to sample to be furnished.
4	Sherman Petrie, New York City	1.99	10 months	19,900	Granite.
5	Brown & Fleming, New York City*	1.29	12 months	12,900	Lowest bid. New York stone and Connecticut River granite.
6	William H. Morton, New York City	2.38	13 months	23,800	Stone from Housatonic River, Conn.
7	Francis H. Smith, New York City	1.94	Dec. 1, 1891	19,400	Kind of stone not stated.
8	John A. Bouker, New York City	2.00	.....	20,000	New York stone.

NOTE.—Amount available for contract work about $13,500.
*Lowest bid; entered into contract January 26, 1891; work in progress.

*Abstract of proposals for dredging in the harbors of Bridgeport, * * * Conn., opened February 10, 1891, by Col. D. C. Houston, Corps of Engineers.*

No.	Name and address of bidder.	Rate per cubic yards (26,000 cubic yards).	Amount of bid.	Remarks.
1	P. J. Brummelkamp, Syracuse, N Y	$0.28	$7,280	
2	Richard Parrott, Newburg, N. Y	.22	5,720	
3	George B. Beardsley, Bridgeport, Conn*	.146	3,796	Lowest bid.
4	Thomas H. Benton, Elizabeth, N. J	.20	5,200	

*** Lowest bid ; entered into contract February 27, 1891 ; work not yet begun.**

Abstract of contracts for improving Bridgeport Harbor, Connecticut, by dredging and by construction of a breakwater, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per ton of stone.	Price per cubic yard of dredging.	Remarks.
Brown & Fleming, New York City.	Jan. 26, 1891	Delivering riprap granite and building breakwater.	$1.29	.....	Work in progress.
George B. Beardsley, Bridgeport, Conn.	Feb. 27, 1891	Dredging*	.....	$0.146	Work not yet begun.

*** Part of a contract for dredging in the harbor of Bridgeport, Black Rock, Five Mile River, and Norwalk; time of commencement specified on or before August 1, 1891.**

COMMERCIAL STATISTICS FOR CALENDAR YEAR OF 1890.

Arrivals and departures of vessels—draft 6 to 18 feet.

	Number.	Tonnage.
Foreign commerce :		
Arrivals	12	1,423
Departures	11	1,100
Domestic commerce :		
Arrivals and departures	24,250	1,781,079
Total	24,273	1,783,602

Cargoes.

	Tons.	Estimated value.
Receipts	904,817	$42,000,000
Shipments	409,340	41,000,000
Total	1,314,157	83,000,000

During 1890, 4,730 vessels, carrying 321,250 tons of cargoes, entered the harbor for refuge.

The amount of collections at this port during the year ending June 30, 1891, was $150,133.54.

The above figures for tonnage of freight show an increase of 297,000 tons over those reported for 1889.

No new lines for transportation have been established since July 1, 1890.

D 12.

IMPROVEMENT OF BLACK ROCK HARBOR, CONNECTICUT.

This harbor, 1½ miles long from northeast to southwest and from 300 to 2,500 feet wide, lies between the mainland on the west and Fayerweather Island on the east, and includes the navigable part of Cedar Creek, a small tidal inlet which extends up into the western part of the city of Bridgeport, and affords water communication of great value to several large manufactories in its immediate neighborhood. It is in the interest of the city of Bridgeport that the improvement of Black Rock Harbor is desired.

The depth in the lower part of the harbor is from 6 to 12 feet at mean low water. This part of the harbor was formerly much used as a refuge for vessels overtaken by storms, but is not deep enough for most vessels now engaged in commerce through the Sound. Before work was done in Cedar Creek the depth there was from 2 to 4 feet, and the channel was narrow and crooked.

The head of the harbor was separated from Long Island Sound on the southeast by a broad, flat sand bar, which was bare at about half tide, and which joined Fayerweather Island with the main shore.

PROJECTS FOR IMPROVEMENT.

Between 1836 and 1838, $21,500 were expended in building a sea wall across a breach in the southern part of Fayerweather Island to preserve the light-house reservation at the south end of the island, and to prevent shoaling on the anchorage ground.

In 1882 a survey of the harbor was ordered by Congress, which was made in 1883. In his report on this survey, dated December 12, 1883, Colonel McFarland, U. S. Engineers, submitted a project providing—

(1) For protecting the upper part of the harbor from the sea by building a breakwater over the bar northeast of Fayerweather Island, to be about a half mile long and 6 feet wide at the top, which was to be 3½ feet above mean high water, or 10 feet above low water.

(2) For making a channel 80 feet wide and 6 feet deep at mean low water, extending up Cedar Creek.

The estimated cost was:

Breakwater	$58,000
Dredging	22,000
Total	80,000

Work under this project was begun in 1885, and up to July 1, 1890, the breakwater had been built to its full length in order to prevent the currents from cutting a channel across the bar, but its cross section was less than designed, both in height and width; also a channel 6 feet deep, or over, had been dredged with width of 80 feet extending from deep water northward up Cedar Creek to within about 500 feet of the head of the creek, being 2,200 feet north of the Forge Company's Wharf. This channel was further widened and deepened in places by private parties.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress, approved September 19, 1890, $5,000 were appropriated for this improvement. Due advertisement was made, proposals for dredging were received, and February 27, 1891, a contract was en-

tered into with George B. Beardsley to do the required work at the rate of 14.6 cents per cubic yard; work has not yet been begun.

This work was part of a contract for dredging in the harbors of * * * Black Rock, * * * and the time of commencement specified was on or before August 1, 1891.

PRESENT CONDITION OF IMPROVEMENT.

The sea-wall built in 1836--1838 across a breach in Fayerweather Island is still effective in preserving the island and preventing the sea from washing over into the harbor. It needs some repair.

The breakwater between Fayerweather Island and the mainland is built to its full length, 2,744 feet, with diminished cross-section.

The 6-foot channel has been dredged to the full width and length projected; it has shoaled at the sides so that in a few places the available width is now less than 80 feet.

PROPOSED OPERATIONS.

Under the contract now in force the channel near the north end of Fayerweather Island will be widened and deepened.

With future appropriations it is proposed to build up the breakwater to the dimensions projected, and to maintain and widen the present channel, as becomes necessary; $20,000 could be profitably expended on this work during the next fiscal year.

Appropriations for the improvement of Black Rock Harbor have been made as follows:

Application.	Date.	Amount.
Building sea wall on Fayerweather Island	1836–1838	$21,500
Survey	Aug. 2, 1882	350
Building breakwater and dredging	July 5, 1884	20,000
Dredging	Aug. 5, 1886	5,000
Do	Aug. 11, 1888	10,000
Dredging (not yet expended)	Sept. 19, 1890	5,000
Total		61,850

Black Rock Harbor is in the Fairfield collection district, of which Bridgeport is the port of entry. There is a light-house at the harbor entrance. Fort Hale, New Haven Harbor, the nearest work of defense, is 20 miles east.

Money statement.

July 1, 1890, balance unexpended	$1,336.43
Amount appropriated by act approved September 19, 1890	5,000.00
	6,336.43
June 30, 1891, amount expended during fiscal year	1,219.05
July 1, 1891, balance unexpended	5,117.38
July 1, 1891, amount covered by uncompleted contracts	3,796.00
July 1, 1891, balance available	1,321.38
Amount (estimated) required for completion of existing project	40,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

*Abstract of proposals for dredging in the harbors of * * * Black Rock, * * * Connecticut, opened at New York City February 10, 1891, by Col. D. C. Houston, Corps of Engineers.*

No.	Name and address of bidder.	Rate per cubic yard (26,000 cubic yards).	Amount of bid.	Remarks.
1	P. J. Brummelkamp, Syracuse, N. Y	$0.28	$7,280	
2	Richard Parrott, Newburgh, N. Y	.19	4,940	
3	*George B. Beardsley, Bridgeport, Conn	.14 6/10	3,796	Lowest bid.
4	Thomas H. Benton, Elizabeth, N. J	.20	5,200	

*Entered into contract February 27, 1891; work not yet begun.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Freight received and shipped by water.

Articles.	Tons.	Value.
Coal	32,300	$119,700
Iron and steel	6,150	193,150
Miscellaneous	3,618	76,585
Total	42,068	389,435

Vessels used in above traffic.

[Draft, 6 to 12 feet; tonnage, 50 to 450 tons.]

Steamers	118
Sailing vessels	83
Barges	243
Total	444

In addition to above, 2,500 vessels anchored in Black Rock Harbor for refuge during 1890.

The above figures show an increase in tonnage of freight over that reported for 1889 of 4,703 tons.

No new lines of transportation have been established since July 1, 1890.

D 13.

IMPROVEMENT OF NORWALK HARBOR, CONNECTICUT.

Norwalk Harbor or River is a tidal estuary, with a narrow channel extending about 3 miles north from Long Island Sound to the town of Norwalk. Above Norwalk the river is a small fresh-water stream. South Norwalk is on the west bank of the river, 1½ miles below Norwalk. At this point the river is crossed by two drawbridges, the lower one a highway bridge, and the other (450 feet above) the bridge of the New York, New Haven and Hartford Railroad.

In 1867 a company was incorporated under the laws of the State of Connecticut for the improvement of the river. Little work was done,

and when improvement was begun by the United States the low-water depth to South Norwalk was 5 feet, and to Norwalk but 1 foot.

PROJECTS FOR IMPROVEMENT.

By act of March 2, 1829, Congress appropriated $80 "for making a survey of the harbor of Norwalk, Conn., with a view to its improvement." The survey was made by Capt. Hartman Bache, U. S. Engineers, who, in his report on the same dated May 10, 1830, recommended excavating the channel, proposing to build a steam dredge for the purpose. The cost was estimated as follows:

For a channel 12 feet deep at ordinary high water	$15,668.95
For a channel 10 feet deep at ordinary high water	12,286.45

No money was appropriated for carrying out this plan, and in 1871 another survey was ordered by Congress, which was made in the same year. In his report upon the latter survey, dated December 16, 1871, and printed in Senate Executive Document, No. 23, Forty-second Congress, second session, also in the Annual Report of the Chief of Engineers for 1872, page 900, General Warren, U. S. Engineers, submitted a project for dredging a channel 6 feet deep and 100 feet wide from Long Island Sound up to Norwalk, at an estimated cost of $34,000.

In 1880, the terms of the river and harbor act provided that "so much of said appropriation ($5,000) as shall be necessary therefor shall be so expended as to have a channel 6 feet deep at low water between the steamboat landing in said Norwalk and Long Island Sound." As a channel of the projected width (100 feet) and depth of 6 feet at *mean* low water already existed, this was interpreted as requiring a depth of 6 feet at *extreme* low water (see Annual Report of the Chief of Engineers for 1881, Part I, page 609), which would be 8 feet at mean low water, and the project was accordingly modified to provide for obtaining that depth up to South Norwalk, where the steamboat landing was.

The latest estimate, made to include the cost of this modification, and of a large amount of dredging already required to maintain the channel, places the total cost from the time of beginning work at $84,000.

Up to July 1, 1890, the channel below South Norwalk had been dredged 100 feet wide and 8 feet deep at mean low water; above South Norwalk the channel was from 60 to 100 feet wide and 6 feet deep.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $4,000 were appropriated for this improvement. Due advertisement was made, proposals for dredging were received, and February 27, 1891, a contract was entered into with George B. Beardsley to do the required work at the rate of $14\frac{6}{10}$ cents per cubic yard; work has not yet been begun. This work was part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk, and the time of commencement specified was on or before August 1, 1891.

PRESENT CONDITION OF IMPROVEMENT.

The channel below South Norwalk, which has been made 100 feet wide and 8 feet deep at mean low water, is in fair condition, but with the width somewhat decreased by reason of washing in of the banks. Above South Norwalk the channel is 6 feet deep and from 60 to 100 feet wide.

PROPOSED OPERATIONS.

Under the contract now in force the dredged channels will be restored where shoaling has taken place. It seems inexpedient at present to attempt to make and maintain a width of 100 feet above South Norwalk; with this exception the project is completed, except such work as may from time to time be required to maintain the channels. No appropriation is needed for the ensuing year.

Appropriations for improving Norwalk Harbor have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 2, 1829	$80.00
Do	Mar. 3, 1871	1,166.66
Dredging (6 feet) above South Norwalk	June 10, 1872	10,000.00
Do	Mar. 3, 1873	10,000.00
Do	June 23, 1874	10,000.00
Dredging (6 feet) below South Norwalk	Mar. 3, 1875	7,000.00
Do	June 18, 1878	6,000.00
Dredging (6 feet) above and below South Norwalk	Mar. 3, 1879	10,000.00
Dredging (6 feet) below South Norwalk	June 14, 1880	5,000.00
Dredging (8 feet) below and (6 feet) above South Norwalk	Mar. 3, 1881	5,000.00
Dredging (6 feet) above South Norwalk	Aug. 2, 1882	5,000.00
Dredging (8 feet) below South Norwalk	July 5, 1884	5,000.00
Dredging (6 feet) above South Norwalk	Aug. 5, 1886	3,000.00
Dredging (6 feet) above and (8 feet) below South Norwalk	Aug. 11, 1888	*3,000.00
Do	Sept. 19, 1890	4,000.00
Total		84,246.66

*Part of an appropriation of $28,000, of which $25,000 was required to be expended at Wilson Point.

Norwalk is in the Fairfield collection district, and is 11 miles west of Bridgeport, the port of entry.

Norwalk light-house is on Sheffield Island, at the harbor entrance.

The nearest work of defense is Fort Schuyler, Throg's Neck, at the head of Long Island Sound, about 29 miles southwest.

Money statement.

July 1, 1890, balance unexpended	$1,051.12
Amount appropriated by act approved September 19, 1890	4,000.00
	5,051.12
June 30, 1891, amount expended during fiscal year	283.91
July 1, 1891, balance unexpended	4,767.21
July 1, 1891, amount covered by uncompleted contracts	2,920.00
July 1, 1891, balance available	1,847.21

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*Abstract of proposals for dredging in the harbors of * * * Norwalk, * * * Connecticut, opened at New York City, February 10, 1891, by Col. D. C. Houston, Corps of Engineers.*

No.	Name and address of bidder.	Rate per cubic yard (20,000 cubic yards).	Amount of bid.	Remarks.
1	P. J. Brummelkamp, Syracuse, N. Y	$0.28	$5,600	
2	Richard Parrott, Newburg, N. Y	.18	3,600	
*3	George B. Beardsley, Bridgeport, Conn	.146	2,920	Lowest bid.
4	Thomas H. Benton, Elizabeth, N. J	.20	4,000	

* Entered into contract February 27, 1891; work not yet begun.

Abstract of contract for improving Norwalk Harbor, Connecticut, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per cubic yard.	Remarks.
Geo. B. Beardsley, Bridgeport, Conn..	Feb. 27, 1891	Dredging*..	*$0.146	Work not yet begun.

*Part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk; time of commencement specified on or before August 1, 1891.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Arrivals and departures of vessels.

[Draft, 7 to 12 feet; tonnage, 100 to 500 tons.]

	No. of round trips.
Steamers	650
Sail vessels	500
Barges and canal boats	370
Total	1,520

Cargoes.

Articles.	Tons.	Estimated values.
Coal	85,000	$340,000
Lumber (14,000,000 feet)	17,500	350,000
General merchandise	210,000	12,600,000
Total	312,500	13,290,000

This estimate does not cover a considerable fleet of oyster steamers belonging on the river.

No statistics were received for 1889. The above figures show a decrease in tonnage of cargoes of 126,100 tons since 1886, the last previous figures received.

No new lines of transportation were established during the past fiscal year.

D 14.

IMPROVEMENT OF HARBOR AT WILSON POINT, CONNECTICUT.

Wilson Point Harbor is a bay on the north shore of Long Island Sound about 1½ miles west from the mouth of Norwalk River or Harbor. The lower half of the harbor is about half a mile wide, with depth decreasing from 16 feet gradually to 6 feet at Wilson Point; the upper half is from 1,000 to 500 feet wide, with depth of 3 feet or less at low tide. The harbor is sheltered by the mainland and by Sheffield Island (the most westerly of the Norwalk Islands) from all quarters except the southwest; it is partly sheltered from the southwest by "Bell Island," an island separated from the mainland by a marsh and narrow creek.

Wilson Point Harbor has been used to some extent for many years as a harbor of refuge and place to lie up for the night by fishing boats and oyster steamers, and occasionally by barges caught out in storms.

There is no settlement upon the shores of the harbor except a collection of summer cottages on Bell Island.

A few years ago the Danbury and Norwalk Railroad Company (now a branch of the Housatonic Railroad Company) made Wilson Point their terminus, and subsequently the New England Terminal Company was formed to construct docks, car yards, and coal sheds, and to operate in the interest of the Housatonic Railroad and its connections. A large dock was built, with transfer bridges, by which freight cars were taken on board steamers and freight carried to New York City without unloading and reloading.

PROJECTS FOR IMPROVEMENT.

March 3, 1888, a letter was sent by the Hon. William P. Frye, U. S. Senator, to the Secretary of War, asking that a special examination of Norwalk Harbor be made with reference to a developing business which urgently required further improvements; this letter was referred to me for report. Upon inquiry it was learned that the business referred to was that of the railroad terminus at Wilson Point, and that it was desired that the United States undertake dredging a channel 15 feet deep and 300 feet wide up the harbor to the vicinity of the railroad wharves. There was no money available for a detailed examination of the locality, but estimates for dredging, based upon recent U. S. Coast Survey charts, were made as follows:

230,000 cubic yards, at 20 cents	$46,000
Contingencies, 15 per cent	6,900
Total	52,900

The river and harbor act of 1888 made appropriations for Norwalk Harbor, Connecticut, of $28,000, with provision as follows:

> Twenty-five thousand dollars of which shall be expended in dredging and deepening the channel in the lower harbor up to Wilson Point.

Previous to beginning work under this appropriation a large amount of dredging had been done by the railroad company; owing to this and to the low rate at which the Government contract was let, it was possible with the available funds to complete the project, and up to July 1, 1890, the channel had been made 400 feet wide and 15 feet deep at mean low water up to the docks, except a small area adjoining the docks, where dredging was done by the railroad company and the depth made was but 12 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1890.

The act of Congress approved September 19, 1890, appropriated $30,000 for improving the harbor at Wilson Point. After due advertisement proposals were received and a contract for dredging about 125,000 cubic yards of material was entered into under date of January 24, 1891, with A. J. Beardsley & Son, of Bridgeport, Conn., at the rate of 8½ cents per cubic yard. Work was begun February 27, and the contract was completed June 5, 1891, 124,974 cubic yards of mud and sand having been dredged, widening the channel on the east side by 200 feet for a length of 750 feet near the railroad docks, and widening the entire channel on the west side up to the docks, about 80 feet, the depth made being 15 feet at mean low water.

This was all the work desired at the time of advertising for proposals.

The unexpectedly low price of work—8½ cents per cubic yard—left a considerable part of the appropriation above what was needed for the amount of dredging contracted for.

At the request of the New England Terminal Company—the only concern largely interested in improvement of this harbor—and with approval of the Chief of Engineers, it was decided to expend the balance in dredging to widen the main channel on the west side, and to extend it up west of the railroad wharves; the work to be done as an open market transaction, at rates not to exceed the contract rates. This work will be done during the present season.

PRESENT CONDITION OF IMPROVEMENT.

The channel close to the docks, dredged by the railroad company, is 12 feet deep at mean low water; outside of this is a channel 15 feet deep, extending out to deep water in Long Island Sound, 480 feet wide, with an additional width of 200 feet on the east side for a distance of 750 feet south from the docks.

PROPOSED OPERATIONS.

With the available funds this channel will be widened on the west side and will be extended northward along, and about 75 feet distant from, the west side of the dock. This work will be done during the present season; it will complete the improvement of this harbor, as far as now designed, and no further appropriation is required.

Appropriations for improving harbor at Wilson Point have been made as follows:

Application.	Date.	Amount.
Dredging	Aug. 11, 1888	*$25,000
Do	Sept. 19, 1890	30,000
Total		55,000

* Part of an appropriation of $28,000 for Norwalk Harbor, directed by the appropriation act to be expended at Wilson Point.

Wilson Point is in the Fairfield collection district, and is about 14 miles southwest from Bridgeport, the port of entry. Norwalk light-house, on Sheffield Island, is about half a mile south of the harbor. The nearest work of defense is Fort Schuyler, Throg Neck, at the head of Long Island Sound, about 29 miles southwest.

Money statement.

Amount appropriated by act approved September 19, 1890	$30,000.00
June 30, 1891, amount expended during fiscal year	11,784.31
July 1, 1891, balance unexpended	18,215.69
July 1, 1891, outstanding liabilities	30.00
July 1, 1891, balance available	18,185.69

Abstract of proposals for dredging in Wilson Point Harbor, Connecticut, opened by Col. D. C. Houston, Corps of Engineers, January 15, 1891.

No.	Name and address of bidder.	Price per cubic yard (125,000 cubic yards).	Amount of bid.	Remarks.
1	Hartford Dredging Company, Hartford, Conn	$0.14	$17,500.00	
2	Morris & Cummings Dredging Company, New York City.	.12⅜	15,468.75	
3	Chas. A. Du Bois and Henry E. Du Bois, New York City.	.13	16,250.00	
4	Alonzo J. Beardsley and George B. Beardsley, Bridgeport, Conn.*	.08½	10,625.00	Lowest bid.
5	Morris J. Brainard, New York City	.16¼	20,312.50	
6	J. H. Fenner, Jersey City, N. J	.17	21,250.00	

*Lowest bid; entered into contract January 24, 1891; contract completed June 5, 1891.

NOTE.—Amount available for contract work about $25,000.

Abstract of contract for dredging in Wilson Point Harbor, Connecticut, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per cubic yard.	Remarks.
A. J. Beardsley & Son, Bridgeport, Conn.	Jan. 24, 1891	Dredging.	$0.08½	Contract completed June 5, 1891.

COMMERCIAL STATISTICS FOR THE CALENDER YEAR OF 1890.

Freight received and shipped by water.

Articles.	Tonnage.	Estimated value.
Coal	60,000	$240,000
Miscellaneous	161,202	15,000,000
Total	221,202	15,240,000

Vessels arriving and departing.

[Draft 10 to 18 feet; tonnage 200 to 1,000 tons each.]

Steamers	720
Sailing vessels	150
Barges	1,200
Total	2,070

No new lines of transportation have been established at this harbor since July 1, 1890. The above statement shows an increase in tonnage over figures reported for 1889 of 115,052 tons.

D 15.

IMPROVEMENT OF FIVE-MILE RIVER HARBOR, CONNECTICUT.

This harbor is an inlet on the north shore of Long Island Sound, about 2 miles west of the mouth of Norwalk Harbor, Connecticut. It is about 1 mile long and from 300 to 800 feet wide. About three-quarters of a mile above its mouth it runs bare at low tide. At the mouth the depth

is about 3 feet, increasing to 9 feet at a point about 750 feet out into the sound.

The mean rise of tide is about 7 feet.

Since 1848 Five-Mile River has been largely engaged in oyster growing, and in this business now employs about 133 vessels.

These vessels can only enter or leave the harbor at high tide; consequently during their busy seasons they are obliged to lie up for the night at other and less convenient harbors.

PROJECT FOR IMPROVEMENT.

By act of Congress approved August 5, 1886, a survey or examination of this harbor was ordered, which was made in the following fall and reported on under date of December 7, 1886, and printed in the Annual Report of the Chief of Engineers for 1887, Part I, page 639.

In this report a project for improvement was proposed, which consisted in dredging a channel 8 feet deep at mean low water and 100 feet wide, to extend up the harbor and to be about 6,000 feet long; the estimated cost was $25,000. This project was adopted in 1888, when work under it was ordered by the appropriation of $5,000 made by act of Congress of August 11, 1888.

Up to July 1, 1890, 22,938 cubic yards had been dredged under this project, making the channel about 1,500 feet long, 50 feet wide, and 8 feet deep at mean low water.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $5,000 were appropriated for this improvement. Due advertisement was made, proposals for dredging were received, and February 27, 1891, a contract was entered into with George B. Beardsley, to do the required work at the rate of 14.6 cents per cubic yard; work has not yet been begun. This work was part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five Mile River, and Norwalk, and the time of commencement specified was on or before August 1, 1891.

PRESENT CONDITION OF IMPROVEMENT.

The dredged channel is 1,500 feet long, about 50 feet wide, and 8 feet deep at mean low water, extending from the 8-foot curve in Long Island Sound up the harbor; above the dredged channel the depth is 2 feet or less. This dredged channel represents the work done in 1889, being the only work ever done towards improving this harbor.

PROPOSED OPERATIONS.

Under the existing contract it is proposed to extend the channel, and with future appropriations it is proposed to complete it as projected; for this work $10,000 could be profitably expended during the ensuing fiscal year.

Appropriations for improving harbor at Five-Mile River have been made as follows, viz:

Application.	Date.	Amount.
Dredging	Aug. 11, 1888	$5,000
Dredging (not yet expended)	Sept. 19, 1890	5,000
Total		10,000

Five-Mile River is in the Fairfield collection district and is about 13 miles west of Bridgeport, the port of entry. The nearest light-house is on Sheffield Island, nearly 2 miles from the mouth of the harbor. The nearest work of defense is Fort Schuyler, at the head of Long Island Sound, 27 miles southwest.

Money statement.

July 1, 1890, balance unexpended	$179.25
Amount appropriated by act approved September 19, 1890	5,000.00
	5,179.25
June 30, 1891, amount expended during fiscal year	52.38
July 1, 1891, balance unexpended	5,126.87
July 1, 1891, amount covered by uncompleted contracts	3,796.00
July 1, 1891, balance available	1,330.87
Amount (estimated) required for completion of existing project	15,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

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*Abstract of proposals for dredging in the harbor of * * * Five-Mile River, Connecticut, opened at New York City February 10, 1891, by Col. D. C. Houston, Corps of Engineers.*

No.	Name and address of bidder.	Rate per cubic yard (26,000 cubic yards).	Amount of bid.	Remarks.
1	P. J. Brummelkamp, Syracuse, N. Y *	$0.28	$7,280	
2	Richard Parrott, Newburg, N. Y	.19	4,940	
3	George B. Beardsley, Bridgeport, Conn	.146	3,796	Lowest bid.
4	Thomas H. Benton, Elizabeth, N. J	.20	5,200	

*Entered into contract February 27, 1891; work not yet begun.

Abstract of contract for improving Five-Mile River Harbor, Connecticut, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per cubic yard.	Remarks.
George B. Beardsley, Bridgeport, Conn.	Feb. 27, 1891	Dredging *	$0.146	Work not yet begun.

*Part of a contract for dredging in the harbors of Bridgeport, Black Rock, Five-Mile River, and Norwalk; time of commencement specified on or before August 1, 1891.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Bushels of oysters raised	600,000
Value of oysters raised	$360,000
Steamers employed	23
Sailing vessels employed	110
Draft of these vessels ..... feet	2½ to 7½
Tonnage of these vessels ..... tons	3 to 150
Value of these vessels	$210,000

The business done in this harbor does not depend upon tonnage of freight, but upon amount and value of oysters raised. The figures for 1890 are the same as those reported for 1889.

No new lines of transportation have been established since July 1, 1890.

D 16.

IMPROVEMENT OF STAMFORD HARBOR, CONNECTICUT.

This is a small harbor on the north shore of Long Island Sound, about 6 miles east of the New York State line. The harbor consists of a bay about a mile long and a mile broad, and of the mouth of the Mill River, a small stream which is dammed at Oliver Street Bridge, the head of the harbor. The original low-water depth for a mile below the bridge was from 1 to 3 feet in a crooked channel, and the 6-foot curve in the bay was about 6,600 feet below the bridge; the wharves are all in the upper half of this distance.

The mean rise of the tide is 7.9 feet.

PROJECTS FOR IMPROVEMENT.

By act of March 2, 1829, Congress appropriated $100 for "making a survey of the harbor of Stamford, Conn., with a view to its improvement."

The survey was made by Capt. Hartman Bache, U. S. Engineers, in 1829. In his report on the same, dated May 10, 1830, Captain Bache recommended excavating the channel (proposing to build a steam dredge for the purpose), the cost being estimated as follows:

For a channel 12 feet deep at ordinary high water (about 4 feet at mean low water)	$13,250.00
For a channel 10 feet deep at ordinary high water	11,035.20

No money was appropriated for carrying out this plan.

The river and harbor act of 1882 authorized a survey of this harbor, which was made in the following year. In his report on this survey, dated December 12, 1883 (printed in Senate Ex. Doc. No. 50, Forty-eighth Congress, first session; also in the Annual Report of the Chief of Engineers for 1884, Part I, page 672), Colonel McFarland, U. S. Engineers, submitted a project for dredging a channel 80 feet wide and 5 feet deep at mean low water from deep water in the bay up to Oliver Street Bridge, estimated to cost as follows:

Dredging 80,000 cubic yards of mud at 20 cents	$16,000
Contingencies	4,000
Total	20,000

It was not intended to include the removal of the ledge under and just below the bridge.

The beginning of the work under this project was approved by the Secretary of War August 30, 1886, after the first appropriation for improving the harbor had been made.

Up to July 1, 1890, the channel had been dredged 5 feet deep at mean low water, with width of 80 feet for the lower half of its projected length, and 50 feet wide above.

By act of Congress approved September 19, 1890, an examination or survey of Stamford Harbor was ordered, with a view to an extension of the project; after preliminary examination an allotment for survey was made. The survey and report on the same have not yet been made.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The river and harbor act of 1890 appropriated $5,000 for completing this improvement. By authority of the Chief of Engineers dredging was begun April 14, 1891, by Richard Parrott, under open market trans-

action for dredging about 20,000 cubic yards of material at 20 cents per yard.

Up to June 8, 15,550 cubic yards were dredged, widening the channel at the two upper bends, making a depth of 5 feet at mean low water. On June 8 work was suspended, the dredge being required to meet obligations under formal contract elsewhere; it will be resumed and completed later in the season.

PRESENT CONDITION OF IMPROVEMENT.

The dredged channel is 5 feet deep at mean low water and 80 feet wide or over from deep water up to within 1,000 feet of the head of the harbor, except two places where small shoals have formed; near the head of the harbor the width is about 50 feet.

PROPOSED OPERATIONS.

With the remaining available funds the channel will be widened and shoal spots removed. The last appropriation completes the amount originally estimated for this improvement, and its expenditure will practically complete the existing project; small amounts will be required from time to time to maintain the channels. No further appropriation under this project is required for the ensuing year.

Appropriations for improving Stamford Harbor have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 2,1829	$100
Do	Aug. 2,1882	350
Dredging	Aug. 5,1886	10,000
Do	Aug. 11,1888	5,000
Do	Sept. 19,1890	5,000
Total		20,450

Stamford Harbor is in the Fairfield collection district of which Bridgeport is the port of entry. There is a light-house on the Middle Ground at the harbor entrance. The nearest work of defense is Fort Schuyler, Throg Neck, 20 miles to the southwest.

Money statement.

July 1, 1890, balance unexpended	$513.86
Amount appropriated by act approved September 19, 1890	5,000.00
	5,513.86
June 30, 1891, amount expended during fiscal year	2,226.68
July 1, 1891, balance unexpended	3,287.18
July 1, 1891, outstanding liabilities	836.20
July 1, 1891, balance available	2,450.98

COMMERCIAL STATISTICS FOR THE CALENDER YEAR 1890.

Arrival and departure of vessels.

[Draft, 5 to 12 feet; tonnage, 10 to 375 tons.]

Steamers	170
Sailing vessels	370
Barges	160

Freight received and shipped.

Articles.	Tons.	Value.
Coal	16,000	$80,000
Lumber and baryta	20,000	40,000
Miscellaneous	14,000	120,000
Total	50,000	240,000

The above figures show an increase in tonnage of freights over those reported for 1889 of 3,890 tons.

No new lines of transportation have been established since July 1, 1890.

D 17.

IMPROVEMENT OF PORT CHESTER HARBOR, NEW YORK.

This harbor consists of the lower part of the Byram River, and a bay at its mouth opening into Long Island Sound. The river for about 1½ miles from its mouth forms the boundary line between the States of New York and Connecticut. It was formerly navigable to within a few hundred feet of the bridge at Port Chester, a little more than a mile above the mouth.

Before improvement the available depth up to the wharves was about 1 foot at mean low water. The mean rise of tide is 7.4 feet.

PROJECT FOR IMPROVEMENT.

A survey of the harbor was made in 1871, and a project for improvement based on it was submitted and adopted. The project provided for the removal of two rocks, Sunken Rock, at the entrance to the bay, with 5.7 feet low-water depth, to be removed to 11 feet, and Salt Rock, about 1,000 feet above the mouth of the river, partly bare at low water, to be removed to 9 feet depth; it also provided for a breakwater 400 feet long at Byram Point. The estimated cost was as follows:

Sunken Rock, 1,474.5 cubic yards, at $40	$58,980
Salt Rock, 316.3 cubic yards, at $40	12,652
Breakwater at Byram Point	25,000
Total	96,632

Under this project Salt Rock was removed in 1873. No further work was done until 1884, when a survey of the channel was made under the appropriation of August 2, 1882, and a project for expending the funds available in 1884 (about $16,000) was submitted and approved. It provided for making a channel from 60 to 100 feet wide, and 2½ feet deep at mean low water, from the bay to the vicinity of the bridge at Port Chester. This modification was made in deference to the wishes of the business men of Port Chester. The channel was completed to within 150 feet of the bridge in May, 1885. In 1886 9,232 cubic yards of sand and gravel were dredged, straightening the channel and removing small lumps and irregularities.

Under the appropriation of $5,000, made in 1888, the project was modified to omit the removal of Sunken Rock and to change the location of the proposed breakwater, making it extend from Sunken Rock

toward the shore. Sunken Rock was dangerous only because it was submerged and was at the side of the channel; the chanuel width at the rock was ample. A breakwater, with the end on the rock rising some distance above high water, would serve as a beacon, and would be an aid instead of a danger to navigation, besides affording more shelter than the originally proposed breakwater; thus it would take the place both of the breakwater and of the removal of Sunken Rock, together estimated to cost $83,980.

On account of this modification, in the Annual Report of the Chief of Engineers for 1890, the estimated cost of completion of project was reduced from $64,632 to $25,000.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

An appropriation of $5,000 was made for this harbor by act of Congress approved September 19, 1890, and, after duly advertising, proposals for riprap for extension of the breakwater from Sunken Rock shoreward were opened December 15, 1890. A contract dated December 29, 1890, was entered into with John A. Bouker for delivering and placing about 3,500 tons of riprap in the breakwater, at the rate of $1.07 per ton. This work was begun February 23, and completed April 15; 3,369 tons of stone have been delivered and the breakwater extended to low-water mark on Byram Point, a distance of 297 feet.

The contract, which included work on Larchmont Breakwaters as well, was completed June 2.

PRESENT CONDITION OF IMPROVEMENT.

Salt Rock has been removed.

An available channel 2½ feet deep at mean low water, and from 60 to 100 feet wide, has been dredged to a point 150 feet below the bridge; thence to the bridge the width is 25 feet. In front of the wharves, where vessels lie aground at low tide, the bottom has been leveled as nearly as practicable.

Five hundred and eighty-five linear feet of the breakwater have been built with the top 5 feet wide and 1 foot above high water, and with slopes of 1 upon 1; the end of the breakwater resting upon Sunken Rock was built to 5 feet above high water, to serve as a beacon.

PROPOSED OPERATIONS.

With future appropriations it is proposed to extend the breakwater to high-water mark on Byram Point and to maintain and if necessary to deepen the channel of the river.

The estimated cost of completion of the project is $20,000.

Appropriations for Port Chester Harbor have been made as follows:

Application.	Date.	Amount.
Removing Salt Rock	June 10, 1872	$12,000
Dredging in Byram River and Bay	Aug. 2, 1882	15,000
Breakwater	Aug. 11, 1888	5,000
Do	Sep. 19, 1890	5,000
Total		37,000

Port Chester Harbor is in the collection district of New York. The nearest lighthouse is on Great Captain Island, 1¾ miles east of the mouth of the harbor. The nearest work of defense is Fort Schuyler, at Throg Neck, about 15 miles southwest.

Money statement.

July 1, 1890, balance unexpended	$11.21
Amount appropriated by act approved September 19, 1890	5,000.00
	5,011.21
June 30, 1891, amount expended during fiscal year	3,952.52
July 1, 1891, balance unexpended	1,058.69
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for construction of breakwaters at Port Chester Harbor (and at Larchmont Harbor), New York, opened December 15, 1890, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton of 2,240 pounds for stone (7,000 tons).	Number of months required to do the work.	Amount of bid.	Remarks.
1	John S. Howell, New York City	$1.20	7	$8,400	Kind of stone not stated.
2	John Voorhis, Greenwich, Conn.	1.24	8	8,680	Granite from Greenwich.
3	S. & E. S. Belden, Rocky Hill, Conn.	1.23	8	8,610	Brown stone.
4	*John A. Bouker, New York City	1.07	12	7,490	Gneiss; lowest bid.
5	Brown & Fleming, New York City.	1.13	6	7,910	Kind of stone not stated.
6	F. H. Smith, New York City	1.39	†6	9,730	Do.
7	William H. Morton, New York City.	2.48	.....	17,360	Do.
8	Michael Finn and Patrick Mansfield, New York City.	3.25	.....	22,750	Gneiss stone.
9	Sherman Petrie, New York City	1.38	10	9,660	Stone from Greenwich, Conn.

NOTE.—Amount available for contract work about $8,000.
*Lowest bid; entered into contract December 29, 1890; contract completed June 2, 1891.
† Working months.

Abstract of contract for extension of breakwater at Port Chester Harbor, New York, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per ton.	Remarks.
John A. Bouker, New York City.	Dec. 29, 1890	Delivering riprap and extending breakwater.	$1.07	Contract completed June 2, 1891.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Arrivals and departures of vessels.

[Draft, 5 to 8½ feet; tonnage, 25 to 300 tons.]

Vessels.	No.	Tonnage.
Steamers	620	60,000
Sailing vessels	405	22,000
Barges	725	115,000
Total	1,750	197,000

Cargoes.

	Tons.	Value.
Shipments	25,000	$900,000
Receipts	135,000	1,075,000
Total	160,000	1,975,000

The principal articles of commerce by water are manufactured goods, coal, iron, building materials, and miscellaneous merchandise, and farmers' produce.

The above figures show an increase in tonnage of freights since 1889 of 15,000 tons.

No new lines of transportation have been established since July 1, 1890.

D 18.

IMPROVEMENT OF LARCHMONT HARBOR, NEW YORK.

Larchmont Harbor is a bay on the northwest shore of Long Island Sound, about 25 miles by water from the Battery, New York City, and 6 miles southwest from the boundary between the States of New York and Connecticut. The harbor is about half a mile wide and extends rather more than half a mile inland; it is a basin with no definite channel, the low-water depth of 18 feet at the entrance gradually decreasing towards the shores east, north, and west.

The harbor is chiefly used by the Larchmont Yacht Club, but is more or less sought by small coasters and fishing vessels for refuge or for night anchorage. It is exposed to storms from east to south, and during northeast storms heavy seas roll around Long Beach Point, east of the harbor, and compel vessels to go well up into shoal water for shelter.

The entrance is divided into three channels by two rocks, Umbrella Rock, about 800 feet from the west shore, being a large ledge with least depth of 3.1 feet at mean low water, and Huron Rock, about 900 feet southwest from the east shore, a smaller ledge with least depth of 9.8 feet. The channel between the rocks is over 900 feet wide and is the one almost invariably used. There are other rocks inside the harbor which are well known and are marked by spindles. They are too near the west shore to interfere with the use of the harbor for general navigation.

The mean rise of tide is 7.4 feet.

PROJECTS FOR IMPROVEMENT.

The river and harbor act of August 11, 1888, provided for a survey of Larchmont Harbor, which was made the following year. The report on the survey, dated November 26, 1889, was printed as House Ex. Doc. No. 40, Fifty-first Congress, first session, and also in the Annual Report of the Chief of Engineers for 1890, part 1, page 675. With the report were presented two alternative projects for improvement; one for removal of Umbrella and Huron rocks, the other for breakwaters to cover each rock and extend to the nearest shore. The cost of removing the rocks to 15 feet depth at mean low water was estimated at $126,000, and the cost of the two breakwaters at $105,000. At the date of the report the preference of those most interested in the harbor was expressed in favor of removing the rocks. After further consideration they changed their

views, preferring the breakwaters, and in accordance with their petition or request a clause in the first draft of the river and harbor act of 1890, which required that money appropriated for this harbor be expended "to remove obstructions at mouth of harbor" was struck out.

The project for constructing two breakwatersat the mouth of the harbor was approved by the Secretary of War, September 27, 1890, after the first appropriation for improving the harbor was made.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $5,000 were appropriated for this harbor. After duly advertising, proposals were received for beginning the construction of two breakwaters at Larchmont and for extending the breakwater at Port Chester, and a contract for work at both barbors was entered into with John A. Bouker, of New York City, for delivering and placing riprap gneiss at the rate of $1.07 per gross ton. Work at Larchmont was begun April 22 and completed June 2, 4,119 tons of riprap being delivered and 74 linear feet of Umbrella breakwater and 64 linear feet of Huron breakwater being built.

These breakwaters were built to 10 feet height above low water with 4 feet top width, the outer ends being slightly higher to serve as beacons on the rocks.

PRESENT CONDITION OF IMPROVEMENT.

The work of the past fiscal year is the only work done towards improvement of this harbor, and its condition is as described above.

PROPOSED OPERATIONS.

Future appropriations should be applied to completing both breakwaters, as provided for in the project.

The only appropriation for improving Larchmont Harbor is the one of $5,000 made by act of Congress approved September 19, 1890.

Larchmont Harbor is in the collection district of New York. The nearest lighthouse is on Execution Rock, 3 miles southward. Fort Schuyler, about 8 miles southwest, is the nearest work of defense.

Money statement.

Amount appropriated by act approved September 19, 1890	$5,000.00
June 30, 1891, amount expended during fiscal year	4,585.72
July 1, 1891, balance unexpended	414.28
July 1, 1891, outstanding liabilities	33.33
July 1, 1891, balance available	380.95
Amount (estimated) required for completion of existing project	100,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for construction of breakwaters at Port Chester Harbor and at Larchmont Harbor, New York, opened December 15, 1890, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton of 2,240 pounds for stone (7,000 tons).	Number of months required to do the work.	Amount of bid.	Remarks.
1	John S. Howell, New York City.	$1.20	7	$8,400	Kind of stone not stated.
2	John Voorhis, Greenwich, Conn.	1.24	8	8,680	Granite from Greenwich.
3	S. and E. S. Belden, Rocky Hill, Conn.	1.23	8	8,610	Brown stone.
4	John A. Bowker, New York City.*	1.07	12	7,490	Gneiss.
5	Brown & Fleming, New York City.	1.13	6	7,910	Kind of stone not stated.
6	F. H. Smith, New York City.	1.39	†6	9,730	Do.
7	William H. Morton, New York City.	2.48	.....	17,360	Do.
8	Michael Finn and Patrick Mansfield, New York City.	3.25	.....	22,750	Gneiss stone.
9	Sherman Petrie, New York City.	1.38	10	9,660	Stone from Greenwich, Conn.

NOTE.—Amount available for contract work about $8,000.
*Lowest bid: entered into contract December 29, 1890; contract completed June 2, 1891.
†Working months.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Number of yachts entering the harbor during 1890 (estimated)		2,000
Draft of these yachts	feet..	3 to 13
Tonnage	tons..	6 to 300
Number of vessels, other than yachts, entering the harbor during 1890 for shelter or for night		200
Draft of such vessels	feet..	4 to 10
Tonnage	tons..	10 to 300

Freight discharged in Larchmont Harbor in 1890.

Number of cargoes		27
Amount	tons..	1,900

Vessels owned by Larchmont Yacht Club.

[Draft, 3 to 13 feet; tonnage, 6 to 300 tons; total tonnage, 5,000 tons.]

Steamers	47
Schooners	36
Sloops	78
Smaller boats	72
Total	233

This is the first annual report of commercial statistics; it is largely from estimates, as few records are available.

No new lines of transportation have been established since July 1, 1890.

D 19.

IMPROVEMENT OF ECHO HARBOR, NEW ROCHELLE, NEW YORK.

Echo Harbor is a bay on the north shore of Long Island Sound, distant about 24 miles by water from the battery at New York. It is landlocked, except towards the southeast, and has a good anchorage. Nearly all of the water transportation of the town of New Rochelle is carried on through this harbor.

The depth in the bay varies from 6 to 15 feet at mean low water, though the low-water channel up to the wharves is only from 1 to 2 feet deep.

The mean rise of tide is 7.3 feet.

PROJECT FOR IMPROVEMENT.

A survey was made in 1875, and a project based on it was submitted December 20, 1875, and subsequently adopted, providing for the removal of two rocky reefs from the channel, viz:

(1) Sheepshead Reef, lying midway between Echo Island and Duck Point, which had 1.6 feet of water upon it at low tide. This was to be removed to a depth of 9 feet at low water, which required the excavation of 872.5 cubic yards of rock, costing,	$21,201.75
(2) Start Rock, which projects about 2 feet above low water, and lies in the channel 120 feet from Beaufort Point. This was to be removed to 7 feet below low water, requiring the excavation of 370 cubic yards of rock, costing	12,672.50
Contingencies	5,081.13
Total	38,955.38

A depth of 7 feet over Start Rock was obtained in January, 1880, and in 1881–1883 506 cubic yards were removed from the southern part of Sheepshead Reef, making 9 feet depth. In May, 1889, a petition of residents of New Rochelle was submitted, asking that the money then available be expended in dredging up to the wharves. This was approved by the Chief of Engineers, and the money was expended in making a channel 40 feet wide and 4 feet deep at mean low water, extending from the bay to within 300 feet of the head of the harbor, a distance of about 1,050 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The available funds were insufficient to continue the improvement and no work was done.

PRESENT CONDITION OF IMPROVEMENT.

Start Rock has been removed to 7 feet depth at mean low water, and about one-half of Sheepshead Reef has been removed to a depth of 9 feet at mean low water.

The dredged channel is as above described, no other dredging than that of last year ever having been done in this harbor by the United States.

PROPOSED OPERATIONS.

To complete the project there yet remains the removal of the rest of Sheepshead Reef, which can be done with the balance of the original estimate not yet appropriated, $17,000, provided it be available at one time; and it is recommended on the ground of economical expenditure that if further appropriations be made for removal of rocks in this harbor not less than the estimated sum required be appropriated.

Appropriations for improving Echo Harbor, New Rochelle, N. Y., have been made as follows:

Application.	Date.	Amount.
Removal of Start Rock	June 18, 1878	$10,000
Do	Mar. 3, 1879	3,000
Removal of Sheepshead Rock	June 14, 1880	3,000
Do	Mar. 3, 1881	3,000
Dredging	Aug. 2, 1882	3,000
Total	.....	22,000

Echo Harbor is in the collection district of New York. The nearest light-house is on Execution Rock. The fortifications on Throg Neck, 7 miles to the westward, are the nearest works of defense.

Money statement.

Amount (estimated) required for completion of existing project	$17,000
Amount that can be profitably expended in fiscal year ending June 30, 1893	17,000
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Number of steamers arriving and departing		400
Tonnage of same	tons	30,000
Number of sailing vessels arriving and departing		450
Tonnage of sailing vessels arriving and departing		27,000
Number of barges arriving and departing		150
Tonnage of barges arriving and departing		30,000
Number of tons of freight received	tons	90,000
Estimated value of freight received		$1,350,000

The principal articles of commerce are coal, building material, and general merchandise. The New Rochelle Yacht Club, which is largely interested in the removal of rocks from this harbor, includes about 100 vessels, ranging in size from 60 tons downward.

The above figures show an increase in tonnage of freights of 4,000 tons since 1889. No new lines of transportation have been established during the past year.

These figures are estimated from the best sources attainable. No complete records of harbor commerce are kept.

D 20.

IMPROVEMENT OF NEW ROCHELLE HARBOR, NEW YORK.

New Rochelle Harbor is situated at the west end of Long Island Sound, on its north shore, about 10 miles southwest of the boundary between the States of New York and Connecticut; it lies off the southerly part of the town of New Rochelle, while Echo Harbor is off the northerly part. The harbor itself consists of rather narrow and circuitous passages between several rocky islands and reefs, which shelter it from rough weather. The original depth of the main channel in this harbor was from 8 to 9 feet at mean low water. There were two rocks in or near the channel way whose removal was desired, and the narrowness of the deep-water channel at the head of the harbor made it necessary for steamers to back out.

Glen Island, a popular summer day resort for excursion and picnic parties from New York City, lies in the middle of this harbor. Between the harbor and Long Island Sound lies David Island, one of the principal recruiting posts for the Army.

The improvement of this harbor was desired chiefly in the interest of Glen Island as a summer resort. No harbor improvement seems to have been needed for David Island, and the commerce by water for New Rochelle is carried on almost wholly in Echo Harbor.

PROJECTS FOR IMPROVEMENT.

A survey of New Rochelle Harbor was ordered by the act approved June 14, 1880, and made in the same year In the report of this survey, January 28, 1881, a project for improvement was submitted contem-

plating the removal of Corning Rock to 12 feet depth at mean low water, of Rock C to 9 feet depth, the dredging of a channel 100 feet wide and 8 feet deep around the south end of Glen Island to connect with the channel around the north end of that island, and the removal of a reef that obstructed the entrance to this projected channel, the whole being estimated to cost $40,825. The object of this dredging and rock removal was to allow vessels to pass around the island instead of having to turn in the narrow channel.

In 1881 the channel around Glen Island was dredged 100 feet wide and 6 feet deep, and work was begun under a contract to remove the reef at the channel entrance to 8 feet depth. The contract was extended, and in 1883 work was abandoned by the contractor while parts of the rock were still from 1 to 1½ feet above the plane of removal required.

In 1883 Corning Rock was removed to 12 feet depth by hired labor, at a cost of about $34 per cubic yard.

A large bowlder was removed from near David Island Wharf, and 106 cubic yards of loose rock were removed from the reef at the entrance to the dredged channel, making a depth of 7.5 feet there.

An examination of the dredged channel and the rocks at the entrance was made in April, 1887. By this examination a reef was discovered, not shown on the original survey, projecting about 40 feet into the proposed channel, with a least depth of 6 feet; also a rock known as Rock B, projecting about 10 feet into the proposed channel, with a least depth of 2.9 feet. Authority was obtained, under date of April 30, 1887, to complete the removal of the rocks at the entrance by hired labor and to deepen the dredged channel to 8 feet depth at mean low water by contract.

The removal of the rock was completed in 1888, making 8 feet depth at mean low water upon Rock B and a depth of 7½ feet or over upon the above-mentioned reef.

In 1890 the available balance of the appropriation of 1882 was expended in dredging 40,700 cubic yards of mud from the channel south of Glen Island, making the channel 8 feet deep at mean low water and 100 feet wide for a distance of about 1,600 feet, connecting deep water back of Glen Island with deep water outside.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The available funds were insufficient for work, and nothing was done.

PRESENT CONDITION OF IMPROVEMENT.

Corning Rock has been removed to 12 feet depth, and the reef at the south entrance to channel around Glen Island has been removed to make a channel 100 feet wide and fully 7½ feet depth. The rest of the channel around Glen Island is 8 feet deep and 100 feet wide or over.

PROPOSED OPERATIONS.

The project for improvement is practically completed, except the removal of Rock C. This does not now appear to be necessary, therefore no further work is now proposed.

Appropriations for the improvement of New Rochelle Harbor have been made as follows:

Application.	Date.	Amount.
Dredging and partial removal of rock at mouth of Glen Island Channel	Mar. 3, 1881	$20,000
Removing Corning Rock and dredging	Aug. 2, 1882	15,000
Total		35,000

New Rochelle Harbor is in the collection district of New York. The nearest lighthouse is on Execution Rock. The fortifications at Throg Neck, 7 miles west, are the nearest works of defense.

Money statement.

July 1, 1890, balance unexpended	$219.93
June 30, 1891, amount expended during fiscal year	219.93

D 21.

IMPROVEMENT OF EAST CHESTER CREEK, NEW YORK.

East Chester Creek, called also Hutchinson River, is a small stream, which, as a tidal inlet for the last 4 miles of its course, traverses marshes of one-quarter to 1 mile in width, and empties into East Chester or Pelham Bay, a large bay on the northwest shore of Long Island Sound, just east of Throg Neck, and 20 miles by water from the Battery, New York City. The width of the creek varies from 25 feet to a half-mile at high water, but the channel is narrow everywhere.

Pelham bridge, a highway bridge, crosses the creek near its mouth. A short distance above is the bridge and trestle of the Harlem River branch of the New York, New Haven, and Hartford Railroad, and at Lockwood, about 2¼ miles above its mouth, the stream is crossed by the Boston road. All three bridges are drawbridges.

The mean rise of tide at the mouth of the creek is 7.1 feet.

For half a mile up the creek there was originally a channel from 3 to 9 feet deep at low water, but the depth decreased further up, and at Town Dock, the principal landing, about 1½ miles from the mouth, the available depth at high water was only about equal to the rise of the tide. Above Town Dock the stream was narrow and crooked and the depth about the same.

The commerce at Town Dock was principally in coal and building materials for the villages of East Chester and Mount Vernon; the latter is a rapid-growing place, with a present population of about 14,000. The main part of the village is about 2 miles from Town Dock. It is understood to be mainly for the benefit of prospective Mount Vernon commerce that the improvement of East Chester Creek is desired.

PROJECTS FOR IMPROVEMENT.

In 1871 a survey of East Chester Creek was ordered by Congress; it was made in the same year, and in the report, dated January 19, 1872, and printed in the Annual Report of the Chief of Engineers for 1872, page 812, three plans of improvement were outlined, viz:

For making and maintaining by means of a tidal basin and system of dikes, a channel 9 feet deep at mean low water, estimated to cost $1,646,000.

For making and maintaining in the same way a channel of 11 feet deep at mean high water (about 4 feet deep at low water), estimated to cost $731,000.

For securing 7 feet depth of slack-water navigation by means of a lock above Goose Island (about half a mile from the mouth of the Creek), estimated to cost $300,000.

No recommendation as to the worthiness of improvement accompanied these estimates. March 25, 1872, the House of Representatives passed a resolution inquiring the cost of removing obstructions between tide gauges No. 1 and No. 2, so as "to afford the same depth of water above station No. 1 as now prevails below it." In reply to this resolution a report was submitted April 3, 1872 (see Annual Report of the Chief of Engineers for 1872, page 814), containing the following estimates:

Basin, purchase of site, 18 acres, at $150	$2,700
Excavation to level of mean low water, 200,000 cubic yards, at 40 cents	80,000
Excavation of cut, 60,000 cubic yards, at 40 cents	24,000
Diking and revetting banks of cut	12,000
Engineering and contingencies	17,805
Total	136,505

This plan contemplated (as appears from maps on file) straightening the channel at Lockwood, and, as it was necessary in any case to replace the old arch bridge of the Boston road by a drawbridge, to change the location of such bridge to a point about 700 feet eastward, so as to give a straighter and cheaper channel for the stream.

In 1873 $25,000 was appropriated for improving East Chester Creek. It was designed to expend it in accordance with the above estimates, which were then considered an adopted project, but no means had been provided for acquiring the land needed for the proposed cut at Lockwood, so no work was done at that time.

In 1875 it became apparent that the proposed change of location of the drawbridge at Lockwood could not be made. The old bridge lay on the boundary between the towns of East Chester and Pelham, and was supported by the towns jointly. Under the proposed change of location the new bridge would lie within the town of Pelham, which town would then have to support it; therefore the town of Pelham would not consent to the change, and the old bridge was replaced by an iron drawbridge in the same location. The proposed location of the cut had, therefore, to be altered, to bring it to the drawbridge This necessitated excavating a considerable amount of rock at an increased of cost of $10,000. (See General Newton's letter to the Chief of Engineers, September 24, 1875.)

In 1875 $12,000 more was appropriated for this improvement, but it was not until 1877 that a commission, appointed by the State of New York, finally obtained the land for the proposed cut. After this right of way was secured, in 1877, a contract was entered into for making a cut of 9 feet deep at mean high water (2 feet at low water), with a width of 100 feet at high-water level. This contract included about 3,149 cubic yards of rock excavation, 1,210 linear feet of pile dike, and 140 linear feet of crib dike. It was completed in 1878, and in that year and 1879, under an appropriation of $10,000 made June 18, 1878, dredging was done by

hired labor, removing a shoal of bowlders just outside of Pelham bridge, and making a channel about 125 feet wide and 9 feet deep at high water on the west side of Goose Island, being an extension of the original project.

In 1879, $3,500 was appropriated for continuing the improvement, and $3,500 in 1880; these appropriations were not expended until 1884.

In the Annual Report for 1879 it was stated as necessary to complete the improvement from Pelham bridge to Lockwood, "to construct dikes from the lower end of the cut to Goose Island a distance of 5,800 feet." In 1880, these dikes were estimated to cost $40,000.

The appropriations made were not large enough to warrant beginning the cut above Lockwood, or the above-mentioned dikes, and these proposed works were apparently abandoned for the time being. In 1881 General Newton, U. S. Engineers, then in charge, reported that,

> Furthermore, until it is proved that a depth of 9 or 10 feet * * * can not be maintained under the scale of improvement already completed, it will be unnecessary to inaugurate new works. The amount of funds available, $7,372.14, will be quite sufficient for the present wants of the case.

This money was expended in 1884 in dredging just below Town Dock, a work not included in the original estimate.

August 5, 1886, $10,000 were appropriated for this improvement, which was mostly expended in 1888 and 1889, in dredging between Town Dock and Lockwood, to remove shoals from the previously dredged channels.

In 1887 an estimate was made of the cost of the several proposed extensions of project, from which it appears that $84,600 have been either expended or estimated for works not included in the first estimate, and that estimate, therefore, should be increased to $221,000, if it is proposed to carry out the original plan with these extensions.

It was proposed to expend the appropriation of $5,000 made August 11, 1888, in dredging a cut above Lockwood, and in January, 1889, the line of cut was staked out, and a description given to the State commissioners, for securing right of way. They were asked to obtain permission to deposit the material on the marsh lands adjacent to the cut, which could be done cheaply as compared with the cost of carrying it out into Long Island Sound. The commissioners reported that this consent could not then be obtained, and as the available funds were not sufficient to begin work under any other plan for disposing of dredged materials, work was postponed until larger appropriations should be made.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

No work was done. Negotiations are reported to be in progress, with a view to providing for the deposit of dredged materials upon adjacent marsh land.

PRESENT CONDITION OF IMPROVEMENT.

There is a channel not less than 9 feet deep at mean high water (2 feet at low water) from the bay up to Lockwood being about 100 feet wide to a point 1,000 feet above Town Dock, thence to Lockwood from 50 to 75 feet wide. The dikes on the east side of the channel below Lockwood are in fair condition.

The cut above Lockwood has not been begun.

PROPOSED OPERATIONS.

The proposed dikes below Town Dock do not seem to be necessary at present as a means of improving or maintaining the channel, and probably they may be altogether dispensed with.

The completion of the project requires the excavation of a channel 100 feet wide and 9 feet deep at mean high water up to tide gauge No. 1, a distance of about 3,000 feet through marsh lands, and not closely following the windings of the stream. In my annual report for 1890 I stated that:

> The cost of towing dredged materials from this locality to the authorized dumping ground is so great that very little can be accomplished with the available funds unless arrangements can be made to deposit the material to be excavated upon the banks. It has been impossible so far to obtain the consent of the property owners to this. Unless this is done, and larger appropriations for the improvement are made than have been heretofore, it will be useless to continue it.

Recently a company, known as the Mount Vernon Suburban Land Company, has been organized for the purpose of improving the property above Lockwood. This company is very desirous that the projected improvement of East Chester Creek should be completed, and it has undertaken to secure from property owners, and without expense to the United States, the consent to deposit dredgings upon the marsh lands near the proposed channel.

I append to this report a letter received from Mr. J. E. Bryant, secretary and general manager of the company, stating the progress made in this direction. As soon as the right of way is obtained and the promised permission to deposit material upon the bank is received work upon this improvement can be resumed.

REVISED ESTIMATES.

As it is probable that the projected diking below Lockwood will not be found necessary, the estimated cost of completion of project can be materially reduced from the amount of $152,100, heretofore reported. The work now required to complete the project is the widening of a part of the channel below Lockwood, for which the available funds are sufficient, and the extension to "Tidal Station No. 1," about 3,000 feet above Lockwood, for which the following estimates are submitted:

For dredging above Lockwood, 160,000 cubic yards, at 30 cents per yard	$48,000
Supervision and contingencies, about 15 per cent	7,000
Estimate of cost of completion	55,000

being a reduction of $97,000 from the previous estimates.

Appropriations for improving East Chester Creek have been made as follows:

Application.	Date.	Amount.
Cutting through marsh and rock and diking (in 1877)	Mar. 3, 1873	$25,000
Dredging under Boston Road Bridge and at Goose Island	Mar. 3, 1875	12,000
Dredging near Lockwood, Goose Island, and Pelham Bridge	June 18, 1878	10,000
Dredging 40 to 90 feet wide from Pell Point to Town Dock	Mar. 3, 1879	3,500
	June 14, 1880	3,500
Dredging above Town Dock (not wholly expended)	Aug. 5, 1886	10,000
Not yet expended	Aug. 11, 1888	5,000
Total		69,000

East Chester Creek is in the collection district of New York.

The nearest light-house is on the "Stepping Stones," 3 miles southeast of the mouth of the creek. The nearest work of defense is Fort Schuyler, Throg Neck, about 3½ miles south.

Money statement.

July 1, 1890, balance unexpended	$7,141.03
July 1, 1891, balance unexpended	7,141.03
Amount (estimated) required for completion of existing project	55,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	55,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Vessels arriving.

Schooners	9
Sloops	3
Barges, scows, canal-boats, etc	100
Total	112

Freight received.

	Tons.
Lumber, 37,000 feet, being about	55
Building material	550
Posts	100
Stone	9,300
Water pipe (iron)	1,200
Coal	6,500
Ice	1,800
Total	19,505

The above figures show an increase over tonnage reported for 1889 of 3,860 tons.
No new lines of transportation have been established since July 1, 1890.

LETTER FROM THE SECRETARY OF THE MOUNT VERNON SUBURBAN LAND COMPANY DATED JUNE 26, 1891, AND REFERRING TO COMMERCE OF EAST CHESTER CREEK.

DEAR SIR: In answer to a letter of the 12th instant, inclosing a blank form for commercial statistics of East Chester Creek for the calendar year 1890, and requesting me to furnish the same, and to add any facts or figures which I may think worthy of mention in that connection, I inclose the statistics asked for, which I have been careful to make accurate.

The business men of Mount Vernon are deeply interested in the improvement of the river. The commerce is slowly increasing, but it would increase with much greater rapidity if the necessary improvements to the river were completed.

H. and C. Prusser, wood and coal dealers, who have not heretofore shipped wood or coal by the river, will the coming year ship to Lockwood dock about 6,000 tons of coal and 800 cords of wood, adding at least 24 canal-boats and 4 sloops to the number of vessels employed on the river. They have just completed at Lockwood dock a large building with modern improvements for handling their coal.

Turner & Martens, who shipped but a few barge loads of blue stone in 1890, expect to ship 18 or 20 in 1891, with an average of 250 tons to the barge.

Samuel Smith, who shipped but 1 barge load of blue stone in 1890, will ship at least 12 barge loads in 1891, with an average of 250 tons each.

D. G. Benton, lumber dealer, who employed 25 canal-boats and 4 schooners in 1890, would add very largely to his business if the improvements on the river were completed.

John P. Hollers, dealer in ice, who shipped 12 canal-boats in 1890, said that he would add very largely to his business if the river were improved.

There are but a few of the business men of Mount Vernon who would not be glad to ship freight by the river, if the necessary improvements were made.

Mount Vernon is a city of more than 14,000 inhabitants, and its population is rapidly increasing. Its commerce is already considerable and is increasing in value.

I expect in a few days to lay before you a statement prepared by the Board of Trade, giving some estimate of the commerce of Mount Vernon, and of the great value of the proposed improvements of the river to its people.

I am, very truly,

J. E. BRYANT.

Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

LETTER OF GENERAL MANAGER OF MOUNT VERNON SUBURBAN LAND COMPANY, DATED JULY 1, 1891.

MOUNT VERNON SUBURBAN LAND COMPANY,
New York, July 1, 1891.

DEAR SIR: In compliance with your verbal request I write you concerning the progress made in securing the right of way for the proposed canal from Lockwoods Bridge to Tide Gauge No. 1, about 3,000 feet, and the right to deposit the material to be excavated upon the banks.

While as yet no formal consent has been asked for from the property owners, the right of way and the right to deposit the material can be at any time obtained from Mr. Secor, Mr. Von Gossbeck, the Mount Vernon Suburban Land Company, and, I am informed, Mr. Provost. Arrangements are now being completed to secure the same consent from the balance of the property owners, and I assure you that it is now only a question of a short time, in my judgment, when we will secure the necessary consent from them.

Our company has undertaken to accomplish this object, and we are determined to succeed. The matter will be pushed to success as rapidly as possible, and I will keep you informed of the progress made.

I am, very truly,

J. E. BRYANT,
General Manager.

Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

D 22.

IMPROVEMENT OF GREENPORT HARBOR, NEW YORK.

This harbor is a roadstead near the east end of the north fork of Long Island, lying between the north fork on the northwest and north and Shelter Island on the southeast and south. The anchorage ground is exposed to storms from the northeast and east.

A sand spit, called Joshua Point, formerly protected the little bay at Greenport from easterly storms, but in the few years prior to 1883 this had worn away rapidly, and the sand had been carried into the bay.

The mean rise of tide is 2.4 feet.

PROJECT FOR IMPROVEMENT.

The river and harbor act of 1881 ordered a survey of this harbor, the report upon which, dated January 20, 1882, and printed in the Annual Report of the Chief of Engineers for 1882, Part I, page 635, contained plans and estimates for a breakwater (extending to the curve of 18 feet depth), to be built to 3 feet above mean high-water level, with a top width of 5 feet and side slopes of 1 upon 1; the estimated cost was $46,000. The first appropriation for the harbor was made by act of Congress of August 2, 1882, and thereupon the project was adopted as above.

Up to July 1, 1890, 18,196 tons of riprap had been delivered in the breakwater, completing it to a length of 1,570 feet.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By the river and harbor act of 1890, $5,000 were appropriated for improvement of this harbor. At request of parties interested and with approval of the Chief of Engineers the project was modified to provide for raising the breakwater to a height of 5 feet above high water, and for dredging, instead of extending the breakwater 130 feet further as originally designed.

Proposals for building up the breakwater to the required, height were received January 27, 1891, and a contract, dated February 4, 1891, was entered into with Brown & Fleming for delivering and placing in the work about 1,100 tons of granite. Work under this contract was begun April 28, and up to July 1, 1891, 520 tons of stone had been placed, building up the breakwater as required to about 909 feet from the shore out.

After soliciting offers for dredging by circular letter, an offer of the Hartford Dredging Company, to dredge at the price of 18 cents per cubic yard, was accepted. The dredging is to consist in making a depth of 9 feet at mean low water, in order to increase the area of the anchorage basin inside the breakwater. Work upon it is not yet begun.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 1,570 feet long and contains 18,716 tons of riprap; it is in fair condition. No material changes of depth in the harbor has occurred since the survey of 1881.

PROPOSED OPERATIONS.

With the available funds the breakwater will be completed and the dredging of an anchorage basin begun; with further appropriations this basin will be completed as provided in the modified project.

Appropriations for improving Greenport Harbor have been made as follows:

Application.	Date.	Amount.
Survey	Mar. 3, 1881	$500
Expended on breakwater	Aug. 2, 1882	10,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	5,000
Do	Aug. 11, 1888	5,000
Breakwater and dredging	Sept. 19, 1890	5,000
Total		35,500

Greenport is a port of delivery in the collection district of Sag Harbor. The nearest light-house is on Long Beach Point, 3 miles to the eastward. The nearest work of defense is Fort Trumbull, New London Harbor, Connecticut, 21 miles distant in a straight line.

Money statement.

Amount appropriated by act approved September 19, 1890		$5,000.00
June 30, 1891, amount expended during fiscal year		494.15
July 1, 1891, balance unexpended		4,505.85
July 1, 1891, outstanding liabilities	$804.85	
July 1, 1891, amount covered by uncompleted contracts	748.20	
		1,553.05
July 1, 1891, balance available		2,952.80

Amount (estimated) required for completion of existing project.....	$11,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	11,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for enlargement of the breakwater at Greenport, N. Y., opened at Engineer Office, U. S. Army, New York City, January 27, 1891.

No.	Name and address of bidder.	Price per ton for stone (1,000 tons).	Amount of bid.	Remarks.
1	Benjamin Stark, jr., New London, Conn.	$1.60	$1,760	Granite.
2	Brown & Fleming, New York City*.....	1.29	1,419	Granite (lowest bid).
3	Francis H. Smith, New York City.....	2.40	2,640	Granite.
4	Humphrey Toomey, Guilford, Conn	1.37	1,507	Granite. (Bid received 15 minutes after time of opening.)

* Entered into contract February 4, 1891.

NOTE.—Amount available for contract work about $2,000.

Abstract of proposals for dredging at Greenport Harbor, N. Y., opened at Engineer Office, U. S. Army, New York City, June 16, 1891.

No.	Name and address of bidder.	Rate per cubic yard (12,000 cubic yards).	Amount of bid.	Remarks.
1	J. H. Fenner, Jersey City, N. J	$0.19	$2,280	
2	The Hartford Dredging Company, Hartford, Conn* ...	.18	2,160	Lowest bid.
3	Elijah Brainard, New York City	.20	2,400	
4	P. J. Brummelkamp, Syracuse, N. Y	.25	3,000	

*Lowest bid; offer accepted; work not yet begun.

NOTE.—Amount available for work about $2,500.

Abstract of contract for enlargement of breakwater at Greenport, N. Y., in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per ton.	Remarks.
Brown & Fleming, New York City.	Feb. 4, 1891	Delivering riprap granite and building up breakwater.	$1.29	In progress.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

Arrivals and departures of vessels.

Steamers		2,670
Sailing vessels		15,117
Barges, etc		25
Total		17,812
Freight carried by above vessels	tons..	43,500
Draft of these vessels	feet..	6 to 16
Tonnage of these vessels	tons..	50 to 1,000
Number of vessels entered for refuge in 1890 (estimated)		150
Number of vessels repaired by being hauled out on marine railways		375

No new lines of transportation have been established in this harbor since July 1, 1890; a summer line between Hartford, Conn., and Greenport, N. Y., has been discontinued.

The estimated amount of freight reported for 1890 shows an increase of 22,800 tons over that reported for 1889. Undoubtedly the difference is partly due to difference in accuracy of estimates.

D 23.

IMPROVEMENT OF PORT JEFFERSON HARBOR, NEW YORK.

Port Jefferson Harbor is on the north shore of Long Island and about 50 miles east from New York City. It is a mile long and averages three-quarters of a mile wide, and a large part of the area has depths of 18 feet or more at low tide. Tributary to this harbor, on the west, are Setauket Harbor and Conscience Bay, two shallow tidal basins. Port Jefferson Harbor is surrounded on three sides by hills, and is separated from Long Island Sound on the north by a beach of sand and gravel, through which, and nearly in the axis of the harbor, is a single entrance 400 feet wide. This entrance is Port Jefferson Inlet, and through it a tidal reservoir of 2 square miles area receives and discharges some 300,000,000 cubic feet of water with every tide, producing a current whose maximum velocity exceeds 4 miles per hour. In the narrow part of the inlet the depth has always been considerable, but a short distance out into the sound was a broad, flat bar, which originally had a depth of 4 feet at low water. Until the beginning of Government improvement, in 1871, the location of this inlet had been shifting. Since 1838 it had moved westward 790 feet, an average annual rate of 24 feet.

The village of Port Jefferson, with a population of about 3,000, lies at the head or south end of the harbor. The mean rise of tides at the village wharves is 6.2 feet; in Long Island Sound, outside the inlet, it is 7 feet. The difference is wholly in the low-water levels.

PROJECTS FOR IMPROVEMENT.

A survey of the harbor was made in 1853 by Lieutenant Harrison, U. S. Engineers. In 1870 an examination was ordered by Congress. The first project for improvement was submitted by General Warren, January 16, 1871, after an examination, and provided for building a jetty on the east side of the entrance, extending out to the 9-foot curve and rising to 11 feet above mean low water, to be built partly of dimension stone; also for dredging a channel 200 feet wide and 7 feet deep at mean low water through the bar. (See Annual Report of the Chief of Engineers for 1871, page 805.) The estimated cost was as follows:

Construction of jetty	$150,125
Dredging	15,000
Total	165,125

When the project was adopted, under the appropriation of March 3, 1871, it was provided that the jetty should be of rip-rap; rising only to the level of mean high water, except between the high and low water marks on the beach, where it was to be carried to the level of the highest tides; but no change was made in estimates. Under this appropriation 600 feet of the jetty were built; and under the appropriation of June 10, 1872, it was extended to 1,052 feet. An estimate made in 1873 of the cost of completion ($35,000) made the estimate for the whole project $65,000. In 1875 a modification of the project, based on the observed effect of the jetty, was made, providing for a jetty on the west side of the entrance, about 1,075 feet long, and rising 4 feet above mean high water, designed to increase the force of the tidal currents. The width of the channel was also reduced to 100 feet. No new esti-

mate was submitted at the time, but in 1877, after about $8,000 had been expended on the west jetty, it was estimated that $12,250 would be required to complete it, or $20,250 in all. A revised estimate, made in the same year, for the whole improvement, contemplated extending the east jetty to the 9-foot curve, extending the west jetty 600 feet farther, and dredging a channel 100 feet wide and 8 feet deep (this increase of depth on account of increased draft of vessels using the harbor), at an estimated cost of $34,000; $45,000 had then been appropriated and nearly expended, making the total estimate from the beginning $79,000 (including $6,000 appropriated in 1876 and then unexpended). This estimate was incorrectly reported in 1878, but reverted to in 1879, and repeated in each subsequent annual report. In 1877 one cut 25 feet wide and 8 feet deep was dredged through the bar. The channel was dredged to a width of 100 feet under the appropriation of March 3, 1879. In 1877 the east jetty was raised to a height of 5 feet above mean high water and extended 50 feet. In 1878 the west jetty was extended 450 feet, but the height was made only 2 feet above mean low water, except the outer end and an intermediate point, which were raised to 4 feet above mean high water, to serve as guides.

Between 1879 and 1883 both jetties were extended and repaired, making their respective lengths 1,390 feet for the east jetty and 940 feet for the west. This completed the then existing project.

By act of Congress of August 11, 1888, an examination of Port Jefferson Inlet was ordered. A preliminary examination was found sufficient, with recent Coast Survey charts, for all required purposes, and with the report on this examination dated December 5, 1888, and printed in the Annual Report of the Chief of Engineers for 1889, Part I, page 751, were presented plans and estimates for making and maintaining channels through the inlet of 10 and 12 feet depth, respectively. The 10-foot channel was considered by interested parties as sufficient for present needs. The estimates in detail were as follows:

For channel 10 feet deep and 200 feet wide:	
Repairing and enlarging east jetty	$34,200
Repairing and enlarging west jetty	18,150
Dredging	25,390
Contingencies, say	12,260
Total	90,000

Commencement of work under this project for 10 feet depth was approved by the Secretary of War November 1, 1890, after an appropriation had been made for "the project to give a channel 10 feet deep and 200 feet wide."

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $25,000 were appropriated for "improving harbor at Port Jefferson Inlet in the project to give a channel 10 feet deep and 200 feet wide." It was proposed to apply $15,000 of this amount to repairing and enlarging the jetties and $10,000 to dredging. After due advertisement, proposals for riprap for the jetties were received, and under date of February 3, 1891, a contract was entered into with Humphrey Toomey, of Guilford, Conn., to enlarge the jetties, furnishing and placing about 9,000 tons of riprap granite, at the rate of $1.50 per ton. Delivery of stone under this contract was begun May 1, and up to the close of the fiscal year 1,464 tons

had been delivered and placed upon the east jetty, partly completing the work of enlargement over a distance of about 600 feet.

The contract is still in progress.

PRESENT CONDITION OF IMPROVEMENT.

The east jetty is from zero to 2 feet above high water, except in such places as it has been built up under the existing contract.

The peaks in the outer half of the west jetty, built 4 feet above high water, now stand at about high-water level; the low part, built to about 2 feet above low tide, is in fair condition; the shore end, built to 4 feet above high water, is now about 2 feet above high water.

The dredged channel retains its depth of 8 feet at mean low water, but the width has decreased from 100 feet to 75 feet.

PROPOSED OPERATIONS.

With the available funds it is proposed to continue repairing and enlarging the jetties, and to dredge a channel between them of 10 feet depth, and width as great as practicable.

Future appropriations will be applied to completing the work provided for in the project.

Appropriations for Port Jefferson Harbor have been made as follows:

Application.	Date.	Amount.
East jetty	Mar. 3, 1871	$15,000
Do	June 10, 1872	15,000
East and west jetties	Mar. 3, 1875	15,000
East jetty and dredging	Aug. 14, 1876	6,000
East and west jetties	June 18, 1878	8,000
Dredging	Mar. 3, 1879	5,000
East and west jetties	June 14, 1880	3,000
East jetty	Mar. 3, 1881	4,000
Do	Aug. 2, 1882	8,000
Enlarging jetties and dredging	Sept. 19, 1890	25,000
Total		104,000

Port Jefferson is a port of delivery in the collection district of New York. There is a light-house on Old Field Point, 1½ miles west of the harbor entrance. Fort Hale, New Haven Harbor, Connecticut, 23 miles distant is the nearest work of defense.

Money statement.

July 1, 1890, balance unexpended		$347.76
Amount appropriated by act approved September 19, 1890		25,000.00
		25,374.76
June 30, 1891, amount expended during fiscal year		326.87
July 1, 1891, balance unexpended		25,047.89
July 1, 1891, outstanding liabilities	$2,335.31	
July 1, 1891, amount covered by uncompleted contracts	11,302.00	
		13,637.31
July 1, 1891, balance available		11,410.58
Amount (estimated) required for completion of existing project		65,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for enlarging jetties at Port Jefferson Inlet, New York, opened January 15, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Price per ton for stone (9,000 tons).	Time for completion.	Amount of bid.	Remarks.
1	John Beattie, Leetes Island, Conn	$1.87	6 months	$16,830	Granite.
2	Humphrey Toomey, Guilford, Conn*	1.50	7 months	13,500	Granite.
3	Thomas Anderson, Stratford, Conn	2.00	15 months	18,000	Stone according to sample to be furnished.
4	Sherman Petrie, New York City	1.75	10 months	15,750	Granite.
5	Francis R. Smith, New York City	1.84	Dec. 1, 1891	16,560	Granite or gneiss.

*Lowest bid; entered into contract February 3, 1891; in progress.

NOTE.—Amount available for contract work, about $13,500.

Abstract of contract for enlarging jetties at Port Jefferson Inlet, New York, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per ton.	Remarks.
Humphrey Toomey, Guilford, Conn	Feb. 3, 1891	Delivering riprap and enlarging jetties.	$1.50	In progress.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Arrivals and departures of vessels (estimated).

Vessels.	No.	Tonnage.	Draft.
Steamers	481	45,850	From 4 to 13 feet.
Sailing vessels	731	32,875	
Barges	4	488	
Total	1,216	79,213	.....

Freights received and shipped by water.

Total number of tons	42,325
Estimated value	$1,210,000
Number of vessels entered harbor for refuge	300
Number of vessels built in harbor (including *Setauket*)	2
Tonnage of same	516
Number of vessels hauled up for repairs	185
Tonnage	13,332
Number of vessels laid up for winter 1890–'91	60
Tonnage	3,600

D 24.

IMPROVEMENT OF HUNTINGTON HARBOR, NEW YORK.

Huntington Harbor is a land-locked basin about 2 miles long and a quarter of a mile wide, extending in a crooked but generally southern direction from Huntington Bay, from which it is separated by a beach of sand and gravel, through the western end of which a narrow inlet (about 300 feet wide) connects the harbor and bay.

The bay is a large, deep harbor of refuge, on the north shore of Long Island, about 40 miles east from New York City. The harbor has an available depth of about 8 feet at mean low water through the entrance and more than half way up, but in the three-quarters of a mile nearest the head or south end of the harbor the original channel was narrow and decreasing in depth to zero at low tide.

Huntington Village lies about a mile south of the head of the harbor; it has 4,000 to 5,000 population.

The mean rise of tide is 7.2 feet.

PROJECTS FOR IMPROVEMENT.

By act of Congress approved March 3, 1871, a survey of this harbor was authorized. It was made in that year, and with the report, dated December 11, 1871, and printed in the Annual Report of the Chief of Engineers for 1872, page 907, was submitted an estimate of $22,780 as the cost of dredging out a shoal at the entrance to the harbor and of extending the 8-foot channel 150 feet wide for about 2,000 feet up to the old wharf, the property of the town.

By act of Congress of June 10, 1872, $22,500 were appropriated for the harbor, and the project for improvement was completed in April, 1883, the outer shoal being removed to 8 feet depth, and the 8-foot channel being extended 2,200 feet to the old town wharf; the width of 150 feet was, however, reduced to 130 in the last 900 feet length on account of exhaustion of funds. It had been contemplated to dump most of the dredged material in the flats in the harbor, but, on account of much local opposition, this was abandoned after about 2,000 yards had been dumped there, and the rest of the dredged material was deposited in deep water in Long Island Sound. The amount dredged was 91,786 cubic yards.

The river and harbor act of July 5, 1884, ordered a survey or examination of this harbor. A survey was made the same year, the report on which (printed in the Annual Report of the Chief of Engineers for 1885, Part I, page 703 *et seq.*) contains a plan for restoring and maintaining the depth of 8 feet made by dredging in 1872 and 1873, but subsequently lost by settling of the banks, with estimate of cost for carrying the channel up to the old town dock, as follows:

Dredging 84,000 cubic yards, at 25 cents per cubic yard	$21,000
Pile protection, 1,400 linear feet, at 5 cents per linear foot	7,000
	28,000
Superintendence and contingencies	4,000
Total	32,000

with an estimate of additional cost of $10,000, should it be decided to carry the channel up to the last wharf on the east side, a distance of 800 feet farther.

The beginning of work under this project was approved by the Secretary of War November 3, 1890, after an appropriation for the improvement had been made by Congress.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The river and harbor act of 1890 appropriated $10,000 for improving Huntington Harbor. Upon request of a large number of citizens of Huntington it was decided to expend this appropriation in dredging,

to afford the desired relief more quickly, and to leave the question of sheet piling for future consideration.

After duly advertising proposals were received, and under date of March 23, 1891, a contract was entered into with Charles and Henry E. Du Bois, of New York City, to dredge about 45,000 cubic yards, at the rate of $15\frac{9}{10}$ cents per yard. Work under this contract has not yet been begun. The required date for beginning is on or before September 1, 1891.

PRESENT CONDITION OF IMPROVEMENT.

Work under the new project has not yet been begun. The channel dredged in 1872 and 1873 has filled up completely in the upper half; the lower half retains a depth of from 3 to 7 feet at mean low water.

PROPOSED OPERATIONS.

Under the contract now in force the channel will be dredged up to the old steamboat dock, with width as great as the available funds will allow. Future appropriations will be applied to completing the channel and diking, if necessary.

Appropriations for improving Huntington Harbor have been made as follows:

Application.	Date.	Amount.
Dredging	June 10, 1872	$22,500
Do	Sept. 19, 1890	10,000
Total	.....	32,500

Huntington Harbor is in the New York collection district. The nearest lighthouse is on Eaton Point, at the east side of the mouth of Huntington Bay, about 4 miles distant from the harbor. The nearest works of defense are the fortifications at Willets Point, about 20 miles westward.

Money statement.

Amount appropriated by act approved September 19, 1890	$10,000.00
June 30, 1891, amount expended during fiscal year	104.40
July 1, 1891, balance unexpended	9,895.60
July 1, 1891, amount covered by uncompleted contracts	7,155.00
July 1, 1891, balance available	2,740.60
Amount (estimated) required for completion of existing project	22,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	22,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

Abstract of proposals for dredging in Huntington Harbor, New York, opened March 9, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Price per cubic yard (45,000 cubic yards).	Amount of bid.	Remarks.
1	E. R. Seward, Albany, N. Y	$0.17½	$7,987.50	
2	Elijah Brainard, New York City	.17	7,650.00	
3	Hartford Dredging Company, Hartford, Conn	.20	9,000.00	
4	Charles DuBois and Henry E. DuBois, New York City*	.15$\frac{9}{10}$	7,155.00	Lowest bid.
5	Richard Parrott, Newburg, N. Y	.19	8,550.00	

* Lowest bid; entered into contract March 23, 1891; work not yet begun.

NOTE.—Amount available for contract work, about $8,000.

Abstract of contract for dredging in Huntington Harbor, New York, in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per cubic yard.	Remarks.
Charles DuBois and Henry E. DuBois, New York City.	Mar. 23, 1891	Dredging.	*Cents.* $15\frac{9}{10}$	Work to begin on or before Sept. 1, 1891.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

Arrivals and departures of vessels.

[Draft, 5 to 8 feet; tonnage, 70 to 225 tons.]

Vessels.	No.	Tonnage.
Steamers	150	200
Sailing vessels	340	90
Barges, etc	12	225
Total	502	515

Cargoes.

	Tons.	Estimated value.
Freight received	27,500	$500,000
Freight shipped	12,000	200,000

The principal articles of commerce by water are coal, building material, and general merchandise.

Number of vessels engaged in regular trips to and from Huntington, 12; number of vessels owned in Huntington, 15; draft of same, 5 to 10 feet; tonnage, 70 to 400 tons; total tonnage, 2,200 tons.

D 25.

IMPROVEMENT OF GLEN COVE HARBOR, NEW YORK.

Glen Cove Harbor is a small estuary, or creek, opening into the east side of Hempstead Bay, Long Island, about $1\frac{3}{4}$ miles from Long Island Sound and about 27 miles by water from the Battery, New York City. The channel in the creek is about 2 feet deep at mean low water, and a bar at the entrance has a foot less depth. Vessels entering Glen Cove Harbor have to wait for high tide, anchoring in Hempstead Bay, where they are exposed to storms from the north and northwest. When such storms are heavy it is impossible to tow over the bar, and from this cause vessels have been obliged to remain in the bay for 3 or 4 days exposed to heavy seas.

The mean rise of the tide in this harbor in 7.7 feet.

PROJECT FOR IMPROVEMENT.

The act of Congress approved August 5, 1886, provided for a survey or examination of Glen Cove Harbor. A preliminary examination was all that was deemed necessary, and upon this, with the assistance of United States Coast Survey charts recently published, a report, with

estimates of cost of improvements, was presented, dated December 7, 1886, and printed in the Annual Report of the Chief of Engineers for 1887, Part I, page 645.

The plan of improvement described in this report contemplated a breakwater about 2,500 feet long and extending in a general westerly direction from Mosquito Point, on the east side of Hempstead Bay, and north of the entrance to Glen Cove Inlet, the breakwater to be built of riprap, the top to be 5 feet wide and 3 feet above high water, with side slopes of 1 upon 1, at an estimated cost as follows:

136,000 tons of riprap, at $1.35 per ton	$183,600
Contingencies, 10 per cent	18,360
Total	201,960

This project was adopted in 1888, an appropriation being made by Congress for beginning the work, and the location of the shore end of the breakwater was definitely fixed to be at the northwest corner of the Glen Cove Dock and its course to be west-southwesterly toward Mott Point.

Up to July 1, 1890, 19,836 tons of stone had been delivered and 765 linear feet of the breakwater had been built.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

The river and harbor act of 1890 appropriated $15,000 for continuing this improvement. Proposals for delivering riprap were advertised for and opened December 15, 1890, and a contract for delivery of about 15,000 cubic yards of riprap gneiss was entered into with John A. Bouker, under date of December 29, 1890. Work was begun May 29, 1891, and up to the close of this fiscal year 3,024 cubic yards of stone had been placed in the breakwater, extending it 59 linear feet.

PRESENT CONDITION OF IMPROVEMENT.

The breakwater is now 824 feet long and 3 feet wide on top, rising to 1 foot above high water. It contains about 24,372 tons of riprap. It is in good condition.

In order to build a greater length of breakwater with the money appropriated and so to secure some effective shelter at once, the work has not been built up to its full dimensions. It has been made only 3 feet wide on top and 1 foot above high water. It may ultimately require enlarging to the dimensions given in the project.

PROPOSED OPERATIONS.

With future appropriations it is proposed to extend the breakwater and to enlarge it to the cross-section provided for in the project, if necessary. Fifty thousand dollars can be profitably expended for this purpose during the next fiscal year.

Appropriations for improving harbor at Glen Cove have been made as follows:

Application.	Date.	Amount.
Breakwater construction	Aug. 11, 1888	$20,000
Breakwater (as yet partly expended)	Sept. 19, 1890	15,000
Total		35,000

Glen Cove Harbor is in the collection district of New York. The nearest lighthouse is on Sands Point, about 4 miles west. Fort Schuyler, New York Harbor, is the nearest work of defense.

Money statement.

July 1, 1890, balance unexpended		$109.62
Amount appropriated by act approved September 19, 1890		15,000.00
		15,109.62
June 30, 1891, amount expended during fiscal year		370.32
July 1, 1891, balance unexpended		14,739.30
July 1, 1891, outstanding liabilities	$2,527.53	
July 1, 1891, amount covered by uncompleted contracts	9,580.80	
		12,108.33
July 1, 1891, balance available		2,630.97
Amount (estimated) required for completion of existing project		166,960.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for extension of breakwater at Glen Cove, N. Y., opened December 15, 1890, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per cubic yard for stone (15,000 cubic yards).	Number of months required to do the work.	Amount of bid.	Remarks.
1	John S. Howell, New York City	$1.21		$18,150	Kind of stone not stated.
2	John A. Bouker, New York City*	.80	12 months	12,000	Gneiss; lowest bid.
3	Brown & Fleming, New York City	.90	10 months	13,500	Kind of stone not stated.
4	Francis H. Smith, New York City	1.39	6 months	20,850	Granite or gneiss.
5	Wm. H. Morton, New York City	2.51	14 months	37,650	Stone from Housatonic River quarry, or equally as good.
6	Sherman Petrie, New York City	1.20	10 months	18,000	Stone from Greenwich, or equally as good.

*Lowest bid; entered into contract December 29, 1890; work not yet completed.

NOTE.—Amount available for contract work about $12,000.

Abstract of contract for extending breakwater at Glen Cove, N. Y., in force during the fiscal year ending June 30, 1891.

Name and address of contractor.	Date.	Subject.	Price per ton.	Remarks.
John A. Bouker, New York City	Dec. 29, 1890	Delivering riprap and extending breakwater.	$0.80	In progress.

Commercial statistics for Glen Cove Harbor are not yet received.

D 26.

IMPROVEMENT OF FLUSHING BAY, NEW YORK.

Flushing Bay is on the north shore of Long Island, about 14 miles by water from the Battery, New York City. The town of Flushing is on the east bank of Flushing Creek, just above the head of the bay. The

bay is about 1 mile wide and 2 miles long; the bottom is of soft mud, nearly level, the depth in the original channel being not much greater than elsewhere. In 1861 a depth of 5 feet at low water was reported in the channel leading up to Flushing. At the beginning of the improvement by the United States the depth there was but 3.9 feet.

The mean rise of tide is 7.1 feet.

PROJECTS FOR IMPROVEMENT.

A survey of Flushing Bay was made in 1878, and a project for improvement based upon the survey was proposed and adopted. This project provided for constructing two dikes, the first to extend northerly from near the head (or south end) of the bay along the west side of the channel, then, bending, to continue westward to Herrick Point, at the west side of the mouth of the bay, thus forming a large tidal basin, which should fill and discharge through the main channel; the second to start from a point near the middle of the east shore and extend northwardly to the 6-foot curve, confining the channel. It also provided for dredging to make and maintain a channel 6 feet deep at mean low water. The estimated cost of this work was as follows:

Constructing 4,400 linear feet of pile dike, at $10 per foot	$44,000
Constructing 7,800 linear feet of pile dike, at $9 per foot	70,200
Constructing 900 linear feet of pile dike, at $7.50 per foot	6,750
Constructing 3,600 linear feet of single piling, at $3.70 per foot	13,320
For 83,000 cubic yards of dredging, at 20 cents per cubic yard	16,600
Contingencies	22,630
Total	173,500

All the timber work of the dike was to be creosoted.

The first appropriation was expended in building 3,057 linear feet of pile dike on the west side of the channel, extending northward from near the head of the bay. Subsequent appropriations until 1888 were expended in dredging to make and maintain the required channel depth, it being found necessary to dredge repeatedly in the same places. The total amount of material dredged in this period was about 235,000 cubic yards.

In September, 1888, a modification of the original project was approved which provided for "extending the dike northward and towards the west side of the channel at College Point, and for dredging, omitting the dikes running westerly to Herrick's Point, and the single row of piles on the east side."

Up to July 1, 1890, 4,663 linear feet of dike had been built, the outer part of which required addition of riprap to make it permanent.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

Under the appropriation of $20,000 made by the river and harbor act of 1890, riprap stone was purchased by open market transaction, that method being most economical and advantageous to the Government, and from October 21, 1890, to February 7, 1891, 4,515 cubic yards of stone were so placed.

Proposals for dredging were advertised for, and opened June 22, 1891; the lowest bidder was Charles and Henry E. Du Bois, of New York City, with whom a contract will be entered into to do the required work at the rate of 18 cents per cubic yard in scow measurement.

PRESENT CONDITION OF IMPROVEMENT.

The part of the dike built in 1880 to high-water level has settled from a few inches to a foot; the part built in 1889 to 1 foot above high-water level is not yet completely filled with stone.

The channel in the bay, which has been dredged several successive times, has now nearly the required depth of 6 feet at mean low water, but with rather less than 100 feet width.

PROPOSED OPERATIONS.

Under the contract about to be entered into it is expected to restore the full depth and width of the channel, and in order to provide against its frequent shoaling the depth will be made about 2 feet greater than the project calls for.

Owing to strong opposition to the dike by a large number of property owners at Flushing, College Point, and Newtown, representing that it seriously interfered with the navigation of the bay by small craft, I recommended that work on the dike be discontinued. This recommendation having been approved by the Chief of Engineers, the funds available and future appropriations will be expended in dredging.

Appropriations for improving Flushing Bay have been made as follows:

Application.	Date.	Amount.
Construction of dike	Mar. 3, 1879	$20,000
Dredging	June 14,1880	15,000
Do	Mar. 3, 1881	10,000
Do	Aug. 2, 1882	5,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	10,000
Construction of dike and dredging	Aug. 11, 1888	15,000
Repair of dike and dredging	Sept. 19,1890	20,000
Total	.....	105,000

Flushing Bay is in the collection district of New York. The nearest light-house is on North Brother Island, about 3 miles to the northwest. The nearest fortification is Fort Schuyler, about 4 miles to the northeast.

Money statement.

July 1, 1890, balance unexpended	$2,143.41
Amount appropriated by act approved September 19, 1890	20,000.00
	22,143.41
June 30, 1891, amount expended during fiscal year	6,643.39
July 1, 1891, balance unexpended	15,500.02
July 1, 1891, outstanding liabilities	112.10
July 1, 1891, balance available	15,387.92
Amount (estimated) required for completion of existing project	68,500.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	35,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for dredging in Flushing Bay, New York, opened at Engineer Office, U. S. Army, New York, June 22, 1891.

[40,000 cubic yards.]

No.	Name and address of bidder.	Rates per cubic yard.	Amount of bid.	Remarks.
1	Morris & Cummings Dredging Company, New York City.	$0.23	$9,200	Measured in scows.
2	Charles and H. E. Du Bois, New York City.*	.25	10,000	Measured in bank.
		.18	7,200	Measured in scows, lowest bid.
3	James McSpirit, Jersey City, N. J.....	.24	9,600	

*Contract will be entered into with lowest bidder.

COMMERCIAL STATISTICS FOR CALENDAR YEAR 1890.

The statistics received for 1890 are very incomplete and valueless, as showing commerce of the harbor.

The amount of commerce is not materially different from that of 1889, when the following figures were reported:

Arrivals and departures of vessels.

[Draft, 5 to 9 feet; tonnage, 20 to 300 tons.]

Kind.	Number.	Tonnage.
Steamers	830	115,600
Sailing vessels	878	43,200
Barges, etc	732	182,600
Total	2,440	341,400

Cargoes.

	Tons.	Value.
Shipments	135,475	$3,152,400
Receipts	93,760	2,502,425
Total	229,235	5,654,825

The principal articles of commerce are manufactured goods, coal, grain, building materials, and general merchandise.

D 27.

IMPROVEMENT OF PATCHOGUE RIVER, NEW YORK.

Patchogue River is a small stream on the south side of Long Island, emptying into Great South Bay near its eastern end and about 55 miles in a direct line east from New York City. The village of Patchogue, which lies about a mile north of the mouth of the river, has a resident population of about 5,000, which is considerably increased during the summer months.

The approach to Patchogue River by water is through Fire Island inlet, and thence by a rather crooked course for some 14 miles through Great South Bay; the depth through the bay and up to within half a mile of the river's mouth is about 8 feet; at the mouth of the river the depth shoals up to about 2, which depth could be carried up to the village landings.

About the year 1870 the State of New York made an appropriation for improving the entrance to this river. A jetty about 1,000 feet long was built from the west side of the mouth of the river and a channel dredged alongside of it. The jetty was built of a single row of sheet piling, with round piles at intervals of about 6 feet, and riprapped along the sides; in 1891 about 200 linear feet of the piling remained, but badly injured; the riprap could be traced for nearly the whole length of the work, but no trace of the dredged channel remained.

The mean rise of tide at Patchogue River is about 1.1 feet.

PROJECTS FOR IMPROVEMENT.

The river and harbor act of June 4, 1880, provided for a survey of the river, which was made in that year; the report, dated October 30, 1880, and printed in the Annual Report of the Chief of Engineers for 1881, Part I, page 674, contained estimates for a plan of improvement as follows:

The estimate to secure a depth of 6 feet at mean low water by dredging in the river and from its mouth to the 6-foot curve in the bay is	$21,000
For diking from river to 6-foot curve in bay	15,800
Engineering, contingencies, etc., 15 per cent	5,520
Total	42,320

One dike was to be on the west side of the river's mouth, and another and shorter one on the east side; the total length of the two to be 2,400 feet; to be of carbolized timber filled with riprap, and to be from 5 to 7 feet wide from out to out.

Nothing had been done towards the desired improvement; and in1886 another examination (ordered by the river and harbor act of that year) was made.

The report on this examination is printed in the Annual Report of the Chief of Engineers for 1887, Part I, page 759. This report contained a project and estimates for dredging a channel 60 feet wide and 6 feet deep from the highway bridge at Patchogue (4,000 feet above the mouth of the river) to the 6-foot contour in Great South Bay, a total length of about a mile, and to protect the channel in the bay by a dike or jetty on its west side 1,700 feet long; the plan also mentioned the possible necessity of a dike on the east side, but it was not included in the estimates, which were as follows:

Dredging from the head of navigation at the bridge to the 6-foot contour in the Great South Bay, the channel being 60 feet wide and 6 feet deep, would require the removal by scow-measurement of about 60,000 cubic yards of sand, at 30 cents per cubic yard	$18,000
Diking, 1,700 linear feet, at $10 per linear foot	17,000
Superintendence, contingencies, etc	5,000
Total	40,000

Beginning of work under this project was approved by the Secretary of War October 4, 1890, after Congress had made the first appropriation for the improvement.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $15,000 were appropriated for improving Patchogue River, N. Y. Proposals for construction of a riprap jetty on the west side of the entrance were received, and April 18, 1891, a contract for this work was entered into with E. Bailey & Sons, of Patchogue, N. Y., at the rate of $2.80 per gross ton for riprap delivered and placed in position in the jetty. Construction of a similar jetty at Browns Creek, N. Y., was included in the same contract.

Delivery of stone in the Patchogue Jetty was begun June 8, 1891, and up to the close of the fiscal year 450 tons of stone had been placed, building 150 linear feet of the jetty, and partly completing about 900 feet additional.

The contract is in progress.

PRESENT CONDITION OF IMPROVEMENT.

The jetty is as above described, the only work done upon it being that mentioned in this report.

The available depth of channel is still about 2 feet at mean low water; at places in the river considerable dredging has been done by wharf owners to obtain material for filling; the resulting depths are irregular, varying from 8 to 18 feet, and the dredged areas are not continuous.

PROPOSED OPERATIONS.

Under the contract now in force the jetty will be made about 1,200 feet long. As soon as it is sufficiently long to admit of dumping material behind it a contract for dredging at the mouth of the river will be made. The available funds will, it is believed, extend the 6-foot depth a short distance inside the mouth of the river.

Future appropriations should be applied to completing the dredged channel and to extending the jetty, as contemplated by the project.

The only appropriation for Patchogue River is the one of $15,000 made in 1890.

Patchogue River is in the collection district of New York; the nearest light-house is at Fire Island Inlet, 14 miles southwest; the nearest work of defense is Fort Hale, New Haven Harbor, Connecticut, about 35 miles in a direct line northward.

Money statement.

Amount appropriated by act approved September 19, 1890		$15,000.00
June 30, 1891, amount expended during fiscal year		156.18
July 1, 1891, balance unexpended		14,843.82
July 1, 1891, outstanding liabilities	$1,385.00	
July 1, 1891, amount covered by uncompleted contracts	7,140.00	
		8,525.00
July 1, 1891, balance available		6,318.82
Amount (estimated) required for completion of existing project		25,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		25,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for constructing jetties at Patchogue River, New York, opened March 26, 1891, by Col. D. C. Houston, Corps of Engineers.

No.	Name and address of bidder.	Rate per ton (3,500 tons).	Amount of bid.	Remarks.
1	William H. Molthrop & Co., New London, Conn	$2.90	$10,150	
2	Edwin Bailey & Sons, Patchogue, N. Y*	2.80	9,800	Lowest bid.
3	William H. Morton, New York City	5.99	20,965	

* Lowest bid ($16,800, $9,800 for Patchogue River and $7,000 for Browns Creek.) Entered into contract April 18, 1891; work in progress.

The above amounts are included in the proposals for constructing jetties at Patchogue River and Browns Creek, New York.

Amount available for these works, about $17,000.

COMMERCIAL STATISTICS FOR THE CALENDER YEAR 1890.

Arrivals and departures of vessels.

Vessels.	Number.	Tonnage.	Draft.
		Tons.	*Feet.*
Steamers	4	50 to 100	4 to 9
Sailing vessels	200	10 to 300	
Barges, etc	20	50 to 500	
Total	224		

Cargoes.

Freight.	Tons.	Estimated value.
Received	50,000	$600,000.00
Shipped	6,000	50,000.00
Total	56,000	650,000.00

The principal articles of commerce by water are coal and wood, brick and stone, lumber, oysters, and general freight.

D 28.

IMPROVEMENT OF BROWNS CREEK, SAYVILLE, LONG ISLAND, NEW YORK.

Browns Creek is a small stream flowing midway between the villages of Sayville and Bayport, near the south shore of Long Island, and emptying into Great South Bay, about 11 miles northeast of Fire Island Inlet. From Fire Island Inlet to the vicinity of Browns Creek there is a rather crooked channel of about 8 feet available depth. The entrance to the creek is crooked, narrow, and shifting. Its depth at mean low water is about 0.4 foot. In the stream itself the low-water level is from 0.3 to 1.3 feet higher than low water in Great South Bay, and the channel depths are from 0 to 3 feet below low water in the bay. The width

of the stream, from the bay to the highway bridge, about 5,000 feet, averages 77 feet. Its course lies through a sandy marsh from one-quarter to one-half mile in width, separated from the bay by a low and narrow beach.

The permanent population of Sayville is said to be 3,500.

The mean rise of tide in Great South Bay is 1.1 feet; at the highway bridge, except in dry seasons, it is scarcely noticeable.

PROJECT FOR IMPROVEMENT.

In pursuance of the river and harbor act of August 11, 1888, a survey of Browns Creek was made, the report on which was printed in House Ex. Doc. No. 22, Fifty-first Congress, first session, and also in the Annual Report of the Chief of Engineers for 1890, Part I, pages 669–674. With this report plans and estimates for work were presented as follows:

The object of the desired improvement is to secure an anchorage ground or place where the fishing boats can lie in safety during rough weather. This can be accomplished by widening and deepening the creek and improving its mouth. To prevent the entrance from filling up by drift and wave action jetties will probably be needed on both sides, certainly on the west side, as the drift of sand along the shore is from the west to east. The jetties should be of riprip, the top and slopes to be of stone, weighing not less than one-fourth ton, the top to be 3 feet wide and 1 foot above high water, with slopes of one on one. The stone on the top and slopes should be selected and carefully laid, so as to present as smooth a surface as possible, to resist the action of moving ice.

The cost of dredging a channel 100 feet wide and 6 feet deep at mean low water from the 6-foot curve in the bay up to the first bend in the creek (1,850 feet) is estimated to be—

33,000 cubic yards, at 30 cents per cubic yard, the material to be deposited in the bay	$9,900
For a 4-foot channel 100 feet wide above this point to the highway bridge, 4,680 feet, 86,000 cubic yards, at 14 cents per cubic yard, the material to be placed on the banks	12,040
Cost of west jetty, 1,600 feet long, 3,700 cubic yards of riprap, at $2.50 per cubic yard	9,250
Cost of east jetty, 1,400 feet long, 3,100 cubic yards of riprap, at $2.50 per cubic yard	7,750
Contingencies	7,060
Total	46,000

The first work to be done should be the deepening at and near the mouth and the construction of jetties, commencing at the shore end. These works should be carried on simultaneously.

This improvement would not only benefit those engaged in oystering and fishing, but would enable many articles of commerce to be brought to Sayville by water instead of by rail, as at present. A partial improvement would be of great benefit to the small vessels.

The beginning of work under this project was approved by the Secretary of War October 4, 1890, after the first appropriation for improving Browns Creek had been made.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

By act of Congress approved September 19, 1890, $12,000 were appropriated for improving Browns Creek. After due advertisement, proposals for constructing about 1,000 feet of the west jetty and 300 feet of the east jetty were received, the work to be done with riprap, and a contract including this work and similar work at Patchogue was entered into with E. Bailey & Sons, of Patchogue, N. Y., under date of April 18, 1891.

Work on the Browns Creek jetties has not yet been begun; the contract expires December 1, 1891.

PROPOSED OPERATIONS.

With available funds it is proposed to commence both jetties, and as soon as the west jetty is sufficiently advanced to admit of dumping behind it, to dredge by contract, in order to make a 4-foot channel up to and inside the mouth of the creek.

Further appropriations will be applied to completing the jetties and channel as contemplated in the project.

The only appropriation for improving Browns Creek is the one of $12,000 made by act of Congress approved September 19, 1890.

Browns Creek is in the collection district of New York. The nearest light-house is at Fire Island Inlet, about 11 miles southwest. The nearest works of defense are the fortifications at Willets Point, N. Y., about 35 miles west, and Fort Hale, New Haven Harbor, Connecticut, about the same distance northeastwardly.

Money statement.

Amount appropriated by act approved September 19, 1890	$12,000.00
June 30, 1891, amount expended during fiscal year	70.84
July 1, 1891, balance unexpended	11,929.16
July 1, 1891, amount covered by uncompleted contracts	5,600.00
July 1, 1891, balance available	6,329.16
Amount (estimated) required for completion of existing project	34,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	20,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

*Abstract of proposals for constructing jetties at * * * Browns Creek, Long Island, New York, opened March 26, 1891, by Col. D. C. Houston, Corps of Engineers.*

No.	Name and address of bidders,	Rate per ton (2,500 tons).	Amount of bid.	Remarks.
1	Wm. H. Molthrop & Co., New London, Conn	$2.90	$7,250	
2	Edwin Bailey & Sons, Patchogue, N. Y*	2.80	7,000	Lowest bid.
3	William H. Morton, New York City	5.99	14,975	

*Lowest bid $16,800 ($7,000 for Browns Creek and $9,800 for Patchogue). Entered into contract April 18, 1891; work in progress.

The above amounts are included in the proposals for constructing jetties at Pachogue River and Browns Creek, New York.

Amount available for contract works about $17,000.

COMMERCIAL STATISTICS FOR THE CALENDAR YEAR 1890.

SAYVILLE, LONG ISLAND, N. Y., *June 24, 1891.*

DEAR SIR: The following statements are the nearest approximation to the required statistics which the time and conditions permit:

I. There was considerable quantity of freight brought to Sayville by water in 1890; probably an increase of 10 per cent. over any previous year. The amount, in tons, it is almost impossible to approximate, as there is no systematic or statistical record kept of it. The freights consisted principally of coal, lumber, bricks, and other building materials. The draft of vessels bringing these cargoes ranges generally from 3½ to 6 feet. The present method of discharging the cargoes is exceedingly laborious, being first to unload on to scows or flats, which are then poled to as

near the shore as possible, where the water is about 18 inches deep. Teams are here driven into the water, alongside of the scows, and the cargoes are discharged to the wagons and drawn ashore.

II. It will be perfectly safe, upon the best information obtainable, to add 5 per cent. to the number of oystermen and small vessels reported to you at the time of the survey (which would make for 1890 710).

III. The amount of oysters taken during the year 1890 would show according to the most careful estimates, an increase of 10 per cent. over the figures formerly submitted to you (which would make the amount for 1890 192,500 bushels).

IV. A conservative estimate places the quantity of seed oysters brought into and planted in the Great South Bay during the year 1890, from other oyster grounds along the coast, at over 100,000 bushels.

V. In addition to this, it is suggested that in view of the anticipated improvement at Browns Creek there has been a considerable congregation of the oyster shippers, with their establishments, about the mouth of the creek; and that a number of the removals have been made from the Connetequot River to this vicinity. This is an indication of the expected advantages from the improvement about to be made.

Respectfully submitted on behalf of The Village Improvement Society of Sayville and Bayport, by your obedient servant,

JOSEPH WOOD,
No. 71 Broadway, New York, N. Y.

Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

D 29.

PRELIMINARY EXAMINATION OF STONY CREEK RIVER AT STONY CREEK, CONNECTICUT.

[Printed in House Ex. Doc. No. 124, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 23, 1890.

SIR: I have the honor to submit the accompanying copy of report, dated December 20, 1890, by Col. D. C. Houston, Corps of Engineers, giving results of preliminary examination of Stony Creek River, at Stony Creek, Conn., made in compliance with requirements of the river and harbor act approved September 19, 1890.

Colonel Houston states that the interests to be benefited by the desired improvements at this locality are very limited, and are more of a private than public character. He is therefore of the opinion that Stony Creek River is not worthy of improvement by the General Government, and in this opinion I concur.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF COLONEL D. C. HOUSTON, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, December 20, 1890.

GENERAL: I have the honor to submit the following report on preliminary examination of Stony Creek River, at Stony Creek, Connecticut, made in pursuance of the river and harbor act, approved September 19, 1890.

There is no such stream as Stony Creek River, Connectieut, indicated on the charts of the United States Coast and Geodetic Survey or, to my knowledge, on any other published maps. It is understood, however, that it refers to a small tidal creek about half a mile east of Stony Creek village ; the creek is narrow, and extends about three-fourths of a mile inland through a salt marsh, having very little fresh-water flow. The mean low-water depth at the mouth is 1 foot ; above the mouth, the bed is practically bare at low tide. The mean range of tides is 5.3 feet. About 1,000 feet above its mouth the creek is crossed by a small dike or embankment, built to protect the upper marsh lands from overflow, and about 2,000 feet farther up by the Shore Line Division of the New York, New Haven, and Hartford Railroad.

It is asked by interested parties that this stream be improved, so as to give a depth of 6 feet at mean low water up to the railroad crossing, as shown on the attached tracing.* This tracing is copied from a United States Coast Survey chart (No. 3,612, entitled Harbors of Branford, Sachem Head, and The Thimbles, Connecticut scale, 1–10,000, issued November, 1887), which was filed with the Committee on Rivers and Harbors, and on which was written the following:

NOTE.—The straight red lines represent canal already dredged 60 feet wide, 2,190 feet long, depth of water 6 feet low tide. Propose to have this widened to 100 feet whole length. The dotted black and red lines running north to railroad track, 2,400 feet long, are proposed extension of canal 100 feet wide to depth of 6 feet low water, all to be diked both sides, 4,590 feet in length.

To obtain the desired channel would require dredging about 150,000 cubic yards in the creek and 40,000 cubic yards from the mouth of the creek to a depth of 6 feet at mean low water in Long Island Sound, a total length of about 5,000 feet of dredged channel and some diking, or protection, or periodical dredging for maintenance would be required, increasing the cost.

It is not improbable that some rock would need to be removed in the marsh, but the amount, if any, and cost of this can not be even roughly estimated without borings. It would also be necessary to cut through the dike or embankment above referred to.

The interests to be benefited are:

(1) The Branford Granite Company, located west of the mouth of the creek. This company has built a wharf at the mouth of the creek and connected it with the quarries by a railway about one-fourth of a mile long, and has dredged a channel 60 feet wide and 6 feet deep at low tide, extending 2,190 feet from its wharf southward to deep water.

(2) The Stony Creek Red Granite Company, located about half a mile inland (northwest) from the railroad crossing.

(3) The Norcross Granite Company, located near the Stony Creek red granite quarry.

The Stony Creek Red Granite Company proposes, in case the improvement asked for is made, to construct a railway from their quarry, passing under the trestle of the Shore Line Railroad to some convenient point on the channel, in order to ship their stone by water.

It does not seem to me that the improvements asked for are of a public character; they consist mainly in making an artificial channel up a tidal creek, practically bare at low water, to connect with a projected railway, the construction of which is understood to be contingent upon the making of the improvement. Such improvements, in my judgment, are matters of private enterprise.

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*Not reprinted.

Stony Creek is a small village on the shore of Long Island Sound, and, with the Thimble Islands, south of the village and near the shore, it is a summer resort of considerable and increasing popularity. In the summer season excursion steamers run there daily from New Haven, and less frequently from other points. There is but little business done at Stony Creek, except that required for a small population and the additional supplies required for the summer visitors; none of this would be affected by the improvement of Stony Creek River; it is all transacted at the Thimble Islands and in the harbor west of the village. There are several other granite quarries in this vicinity, at Branford, Stony Creek, Leete Island, Sachem Head, etc., but the only parties interested in the desired improvement, as far as I can ascertain, are the three quarry companies mentioned above.

I am, therefore, of the opinion that Stony Creek River, so called, is not worthy of improvement by the General Government.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

D 30.

PRELIMINARY EXAMINATION OF SHAW COVE, NEW LONDON HARBOR, CONNECTICUT.

[Printed in House Ex. Doc. No. 73, Fifty-first Congress, second session.]

ENGINEER OFFICE, U. S. ARMY,
New York, December 4, 1890.

GENERAL: I have the honor to submit the following report on preliminary examination of Shaw Cove, New London Harbor, Connecticut, made in pursuance of the river and harbor act approved September 19, 1890.

Shaw Cove is that part of New London Harbor known on the Coast Survey charts as Coit Cove. It is occupied by wharves, but is crossed by the trestle of the Shore Line Division of the New York, New Haven and Hartford Railroad, in which there is at present an insufficient drawbridge. This cove is the only part of New London Harbor which can be reached from land without crossing railroad tracks close to the water front, as shown on the accompanying printed map* of New London. The importance of improving this part of the harbor is fully shown in the accompanying communication from the New London Board of Trade.

The improvement asked for is a channel 100 feet wide and 12 feet deep at mean low water, extending from the drawbridge along the north and west sides of the cove a total length of above 2,000 feet, and an anchorage basin in the bend of the channel, of the same depth and about 400 by 800 feet. The present depth in these parts of the cove is from $2\frac{1}{2}$ to 8 feet at mean low water, averaging about 4 feet.

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* Omitted.

The estimated cost of such improvement, made from the Coast Survey charts and a recent examination, is as follows:

Dredging a channel, to be about 2,000 feet long, 100 feet wide, and 12 feet deep; 90,000 cubic yards, at 18 cents	$16,200
Dredging an anchorage basin 800 by 400 feet and 12 feet deep; 140,000 cubic yards, at 18 cents	25,200
Contingencies, etc	6,600
Total	48,000

A less amount than this could be expended to advantage.

I am of the opinion that this locality is worthy of improvement. No appropriations have been made for this important harbor, except for removal of part of a shoal lying east of the New London Northern Railroad wharf, in the upper part of the harbor. The amount expended there was $19,800, and that work was substantially completed in 1886.

I would respectfully suggest that if appropriations are made for this purpose they be under the title "Improving New London Harbor, Connecticut."

No further surveys are needed.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

COMMUNICATION OF THE NEW LONDON BOARD OF TRADE.

NEW LONDON, CONN., *November 10, 1890.*

SIR: Replying to your letter of October 20, the board of trade wish to report the following facts, opinions, and statement of present and prospective commerce as reasons why the dredging asked for to be done in Shaw Cove by the United States Government is a worthy improvement.

The board asks that a channel of 12 feet depth at low water and 100 feet wide be dredged from that depth off Chappel's Coal Dock to the drawbridge on line of New York, New Haven and Hartford Railroad and beyond it through the waters of Shaw Cove to reach the docks on north, west, and south of said cove and approximately as indicated by red dotted lines on a map of New London which is filed herewith.*

Also that an anchorage basin be dredged suitable in the judgment of the Corps of Engineers to accommodate the present and prospective commerce as shown hereafter for the purpose of laying up vessels during the winter or dull season.

We make the above request for the following reasons:

The waters of Shaw Cove are navigable waters of the United States.

The present water frontage available for purposes of commerce practically begins at the drawbridge of the New York, New Haven and Hartford Railroad and terminates at the drawbridge of the New London Northern Railroad, a distance of about 4,200 feet. The docks within these limits, now fully occupied, are traversed by railroad tracks either located directly on the bulkheads or close to approaches to the docks. Over these railroads 79 regular trains pass daily, and switching engines pass frequently in addition.

All approaches to these docks are thereby rendered unsafe and the commerce of the port is subjected to great delay, detention, and obstruction in consequence.

The surrounding country, supplied through the port of New London with facilities for landing or discharging cargo or reaching docks for coal, lumber, and other supplies, are particularly timid about crossing tracks to the docks.

The improvement asked for would add about 3,000 feet available water frontage and provide relief from the present overcrowded and inaccessible docks, and by reference to the map it will be seen the waters of Shaw Cove may be reached on north, west, and south sides without crossing any railroad tracks.

In this connection it may be stated that the population of New London has in-

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*Omitted.

creased more than 30 per cent. in the last 10 years. The commerce of the port has increased more than 400 per cent. No increase of dockage is possible without this work, and the entrance into the city of the tracks of the New York, Providence and Boston Railroad, and the reduction of anchorage area in the basin known as Winthrop Cove by these tracks, whereby the vessels accustomed to lay up therein can not now get in, have served to seriously curtail the former conveniences.

The double tracking of the New York, New Haven and Hartford Railroad now going on will still further reduce the use of the water front.

A numerous fleet of coastwise, fishing, and other vessels, both steam and sail, owned not only here but along both shores up the Connecticut River and on Long Island, formerly sought and now desire to use this port by reason of its safety, accessibility, and open water to lay up. These vessels are now unable to get accommodations.

It is desired in these improvements to secure a larger drawbridge at the entrance to Shaw Cove, and another communication has been sent you on this subject.

The amount of the present commerce of the port of New London is difficult to ascertain and perhaps not necessary to present, since it is well known this port is, after New York or Boston, one of the most important in entries, tonnage, and value of cargoes on the seaboard; all of which will be more or less directly benefited by the improvement.

The present commerce of Shaw Cove is limited of necessity by the present insufficient depth of water.

The statements of business now done therein by—

Charles A. Bishop, lumber dealer (673,000 feet of lumber), value	$15,000
John A. Bishop, lumber dealer (600,000 feet of lumber), value	20,000
Fenger and Higgins, coal (2,000 tons), value	10,000

are annexed hereto.

In addition the Pequot Foundry and Machine Works, whose dock at the south side of Shaw Cove can now be reached by vessels of only the lightest draft, receive—

1,000 tons of pig-iron, value	$20,000
800 tons of coal, value	4,000
400 tons of molding sand, value	1,000

The laying-up dock at Daytons and boat-building float at Captain Burdick's require more depth of channel to prosecute the business now done at them.

The business done in Shaw Cove would be increased many times its present volume after the improvement is made.

There are at this writing twenty-two vessels discharging cargo or lying at docks and at anchor for the winter, and following named vessels have either laid up in Shaw Cove or sought accommodation there, or would lay up there if they could get sufficient water, viz:

Steamers.—Sunshine, Margaret, Osprey, Gypsey, Water Witch, D. K. Phillips, Luce Bros., Arizona, Quickstep, Clara Ellen, Emily Foote, S. S. Brown, G. S. Allyn, Amagansett, Acheesnet, E. F. Price, Geo. Hudson, J. A. Morgan, Nat Strong, Peconic, Polland.

Steam yachts.—Surprise, Fidget, Nereid, Shennecosset, Wanda, Estelle, Venture, Narwhal, Starling.

Schooners.—M. M. Brainerd, Frank Butler, Madgie, Chrystal, Maria, White Cloud, Hattie Ellen, E. A. Baker, John Comstock, Ann Elizabeth, Conquest, Hattie Douglass, C. M. Harris, Empire State, Mary and Carrie, Laurel, Joseph Wolley, Nymph, George Temple, Coral, Multnomah, Olive Leaf.

Sloops.—Hepsibah, Sweepstakes, Juliette, Lizzie Morse, George B., Sophia, Wild Pigeon, Diamond, Ferguson.

Schooner yachts.—Lancer, Ruth, Crusader.

Smacks.—E. C. Barry, C. F. Lawrence, Chapel Bros., Isabel, Admiral, Martha, S. R. Packer, Thorn, F. D. Nelson, J. T. Freeman, Kate Church, Gipsy Girl, Belle of the Bay.

Of these only a few more than now in the cove can be accommodated.

In addition to those named, please find the statement hereto annexed of M. Wilson Dart, deputy collector of the port of New London, showing the vessels and tonnage of vessels registered at New London 177, Hartford 84, and Stonington 113, from which number there would be many to make use of an anchorage basin.

We therefore desire to ask your courteous consideration of the foregoing statements and indulge the hope of your favorable finding, and have the pleasure to be,

Very truly, yours,

WILLIAM A. HOLT,
President Board of Trade.
JOHN HOPSON, JR.,
Chairman of Special Committee.

Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

LETTER OF MR. F. E. FENGAR.

NEW LONDON, CONN., *November 5, 1890.*

DEAR SIR: I have to submit the following statements regarding the amount of commerce carried on on Shaw Cove for a period of 1 year, ending November 1, 1890, viz:

Statement of Charles A. Bishop, lumber dealer, 673 M feet of lumber, valued at $15,000.

Statement of John Bishop, jr., lumber dealer, 600 M feet of lumber, valued at $20,000.

Statement of Fengar & Higgins, coal dealers, 2,000 tons of coal, valued at $10,000.

The present draft of water at the drawbridge and into the cove, say 150 yards, is 10 feet at high tide. This draft is insufficient for the carrying on of commerce to any considerable extent. Mr. John Bishop, jr., is obliged to unload 50 per cent. of the vessels consigned to him in New London Harbor and to raft the lumber to his wharf. This extra handling of the lumber entails considerable expense, to say nothing of the depreciation in value of the lumber that comes in contact with the salt water. The present draft of water acts as an embarrassment and hindrance to merchants engaged in business in the cove, as their commodities delivered at their respective places of business cost them more on account of extra expense incurred on account of the draft of water than is paid by merchants engaged in similar enterprises whose yards are located on the river front.

In my opinion the draft of water should be increased to 15 feet at high tide, and a channel 100 feet in width of said depth of 15 feet should extend the length of the cove.

I should have transmitted this memorandum to you before, but was obliged to wait for the statement of Mr. Bishop, jr.

Respectfully, yours,

F. E. FENGAR.

Mr. JOHN HOPSON, Jr.

LETTER OF THE COLLECTOR OF CUSTOMS.

CUSTOM-HOUSE, NEW LONDON, CONN., COLLECTOR'S OFFICE,
November 7, 1890.

DEAR SIR: As requested will give you the tonnage and number of vessels hailing from the ports named:

New London has 177 vessels, the tonnage of which is 38,906.29 gross, 34,031.40 net.

Hartford has 84 vessels, the tonnage of which is 12,629.35 gross, 10,913.60 net.

Stonington has 113 vessels; 5,170.28 gross and 4,614.19 net tons.

If I can be of any further use to you in any way or if any assistance I can render would be of any avail I am at your service.

Respectfully, yours,

M. WILSON DART.

Mr. JOHN HOPSON, Jr.

D 31.

PRELIMINARY EXAMINATION OF CONNECTICUT RIVER, FROM LONG ISLAND SOUND TO HARTFORD, AND BELOW HARTFORD, CONNECTICUT.

[Printed in House Ex. Doc. No. 86, Fifty-first Congress, second session.]

ENGINEER OFFICE, U. S. ARMY,
New York, December 4, 1890.

GENERAL: I have the honor to submit the following report on preliminary examination of the Connecticut River, Connecticut, from Long Island Sound to Hartford, with a view to such improvements as will keep the channel from shifting its course at certain places, and Connecticut River below Hartford, made in pursuance of the river and harbor act approved September 19, 1890.

It is understood that the object of the first examination is indicated by a petition to Congress, of which the following is a copy, omitting signatures:

To the Honorable the Senate and the House of Representatives of the United States of America in Congress assembled:

Your petitioners, whose names are hereto signed and whose post-office address is Glastonbury, in the county of Hartford and State of Connecticut, respectfully represent that the said town of Glastonbury is situated on the east side of the and adjoining the Connecticut River, a navigable river; that said river adjoining this town is a very crooked river; that the meadows adjoining said river are our most valuable lands; that said river, by constantly wearing into said meadows, has in several places changed its bed from two to more than four times the width of the river into and upon our said lands; that heretofore Congress has appropriated money for the improvement of navigation in said river; that so far as said appropriations have been expended opposite to our said meadows, instead of erecting piers and jetties to protect the river bank and hold the river to its (then) proper channel, said piers, etc., were erected on the opposite side of the channel, forcing the river more and more into and upon said meadows, until now said piers, etc., are far beyond the channel of the river; that we respectfully petition Congress to make an appropriation to protect the bank where the river is encroaching upon our meadows as stated, and thus hold the river to its present channel and improve the navigation of the river; that the erection of piers, etc., which will protect our meadows and keep the river within its present channel, will improve said river for navigation as can be done in no other way.

And your petitioners will ever pray.

Dated Glastonbury this 25th day of February, 1890.

The Connecticut River from Hartford to Rocky Hill, a distance, of 11 miles by river and 8 miles in a straight line, including the locality mentioned in the petition, winds through meadows which are generally flooded at high water. The bed of the river is constantly changing by erosion on the concave banks and deposits on the convex banks, so that in many places the river has entirely changed its bed.

It appears from the petition that this is the case at Glastonbury. A project for improving this part of the river by bank protection and dikes was prepared in 1879 and an elaborate report on the subject is printed in the Annual Report of the Chief of Engineers for 1880, pages 398–442. Owing to small appropriations, which were largely consumed in dredging, the only work done under this project was the construction of a dike near Glastonbury on the right bank of the river in 1881, and one at Hartford in 1883. Dredging was continued every year either by the United States or the Hartford and New York Transportation Company. In 1887 it became evident that the completion of the project of shore protection, etc., would not materially reduce the amount of dredging required each year, and it was accordingly discontinued with the approval of the Chief of Engineers. The improvement of this part of the river has since been carried on by annual dredging as being the most economical and efficient method. The matter is fully discussed in my report dated December 21, 1887, printed in the Annual Report of the Chief of Engineers for 1888, page 537.

As to the effect of the dike at Glastonbury in causing the erosion on the opposite bank, referred to in the petition, I would say that the movement of the river bed has been going on from the date of the earliest records. In the report on survey made in 1867 (Annual Report of the Chief of Engineers for 1868, page 772) it is stated that—

> Half a mile above the South Glastonbury Landing there are two piers usually called the Glastonbury piers, marked S and T on the map, and shown on sheet 6. They were built by the Union Company from the left bank of the river, the one above and the other below the entrance of Roaring Brook into the Connecticut.
>
> The channel worked around the east end of pier S about 7 years ago, and was dredged out by the steamboat company, taking off part of the east end of the pier.

The surveys made in 1867 and 1879, before the Glastonbury dike was built, show that the left bank had been moved back by erosion a distance of 800 feet since 1860. A comparison of the surveys made in 1867, 1879, and 1887, before and after the construction of the dike, do not show any greater movement of the bank than would result from natural causes and not nearly so great as has taken place at other points where no works have been built; near Naubuc, for instance, the entire bed of the river has changed since 1867. About 75 feet from the left bank of the river near Glastonbury is a high bluff composed of earth and gravel. The wearing away of the bank at this point will doubtless continue until the high ground is reached, when it will probably cease.

The only object of the bank protection in this part of the river is the protection of land. The cost of this from Hartford to Rocky Hill would be very great, and a continual outlay would be necessary for maintenance. Navigation would not be benefited, and therefore it is not recommended.

The second examination directed in the river and harbor act refers to the entire river below Hartford. The present approved project for this improvement is as follows:

Completing jetties at the river's mouth and dredging between them	$80,000
An average annual expenditure for maintaining the channel from Hartford to Long Island Sound by dredging, of	10,000

This latter dredging has heretofore been done principally in the portion of the river above Rocky Hill, where the bars form every year. Below Rocky Hill the character of the river changes, the banks are generally high, and the channel, except at Pistol Point, practically permanent.

The following work has been done in this section of the river above the mouth:

At Hartford Bar a dike has been built on the right bank of the river (the concave shore), to serve as a training wall.

At Glastonbury Bar a dike has been built on the right bank of the river (the convex shore).

At Hartford Bar, 1½ miles below wagon bridge at Hartford, Clay Banks Bar, 2½ miles below wagon bridge at Hartford, Pratt Ferry, or Naubuc Bar, 5½ miles below wagon bridge at Hartford, Press Barn Bar, 6¾ miles below wagon bridge at Hartford, Glastonbury Bar, 9½ miles below wagon bridge at Hartford, Dividend Bar, 12 miles below wagon bridge at Hartford, dredging has been done nearly every year, and at Pistol Point Bar, 15 miles below wagon bridge at Hartford, Mouse Island Bar, 20½ miles below wagon bridge at Hartford, Haddam Island Bar, 30 miles below wagon bridge at Hartford, mouth of Salmon River, 33 miles below wagon bridge at Hartford, Calves Island Bar, 44½ miles below wagon bridge at Hartford, less frequently, to maintain a navigable channel 9½ feet deep at low water.

A recent examination by Mr. Henry N. Babcock, Assistant Engineer, made in company with parties interested in the petition for this examination, shows the following as the improvement desired, in addition to those included in the approved project:

(1) Middletown Ferry, about 18 miles below Hartford: The ferry crosses the river between Middletown and Portland, Conn., between the lower end of Willow Island and the Air-line Railroad Bridge; a shoal making from the islands crowds the ferryboat's course down too close to the bridge, making it difficult to cross when ice is running in the river,

without striking the bridge. Occasional dredging at comparatively small expense would probably afford the relief desired.

(2) Mouse Island Channel, about 20½ miles below Hartford: This channel has been dredged to a width of 40 to 60 feet; it does not require annual dredging, as it fills up very slowly. It is desired to have the channel made 100 feet wide to accommodate boats from the Portland quarries which have to go up and down in tows, three or four at a time, and can not keep in the narrow channel.

(3) Removal of Bodkin Rock and the point opposite, at "the Straits," about 22 miles below Hartford: It is represented that ice jams frequently form here, and back up the water so as to flood the Portland quarries and cellars in Middletown along the water front. The river makes a sharp bend here, and the channel depth is from 30 to 60 feet.

(4) Chester Rock Channel, 38 miles from Hartford: and

(5) Essex Channel, about 43 miles from Hartford: At both these places the depth is scant 9 feet, and no dredging has ever been done; the cost of deepening the channel would not be great and the work would not require to be done frequently.

This work could all be done under the present project if appropriations were made in accordance with the estimates submitted in the annual reports, except that at Bodkin Rock, where it is represented that ice jams form very frequently, as above stated. The estimated cost of removing Bodkin Rock and the point opposite is roughly $32,000, and it is doubtful whether the desired end would be accomplished. Ice gorges are only temporary obstructions to navigation, and if necessary it is believed that they can be removed by explosives or other means.

No complete survey of this portion of the river has ever been made, though it has been contemplated since 1867. A survey is now in progress by the Coast and Geodetic Survey, and the only additional surveys are those needed to determine the amount of dredging needed at Mouse Island, Chester Rock, and Essex channels. The cost of these would be small and they can be made as usual from the appropriation for improving the river, immediately before undertaking the work.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Second indorsement.]

ENGINEER OFFICE, U. S. A.,
New York, December 8, 1890.

Respectfully returned to the Chief of Engineers.

I am of the opinion that the Connecticut River, Connecticut, from Long Island Sound to Hartford is worthy of improvement by the United States. The estimates for needed improvements were submitted in my annual report for the fiscal year ending June 30, 1890, and are as follows:

Completing jetties at mouth of river	$60,000
Dredging channel between them	20,000
Raising dike at Hartford	50,000
	130,000
Annual cost of maintaining channel from Hartford to Long Island Sound by dredging	10,000

This latter item refers to the average annual cost, as more work is needed in some years than in others. The estimates submitted in my annual reports provide for all work considered necessary.

D. C. HOUSTON,
Colonel of Engineers.

D 32.

PRELIMINARY EXAMINATION OF SAUGATUCK RIVER, CONNECTICUT.

[Printed in House Ex. Doc. No. 179, Fifty-first Congress, second session.]

ENGINEER OFFICE, U. S. ARMY,
New York, January 8, 1891.

GENERAL: I have the honor to submit the following report on preliminary examination of the Saugatuck River, Connecticut, made in pursuance of the river and harbor act approved September 19, 1890.

Improvements at this locality have heretofore been made by the United States for Saugatuck or Westport Harbor, Connecticut, as follows:

In 1827–1836, certain obstructions in the river were removed; the amount of this work is not known, but is supposed to have been very small.

In 1826–1829 and in 1837–'38, a breakwater or sea wall was built on Cedar Point, at the east side of the river's mouth, to secure the beach which was in danger of washing away and into the channel; the breakwater was built about 390 feet long, 10 feet wide on top, and to a height of 4 feet above high water. In 1870 the seas had cut partly through the beach at the north or shore end of the wall and had undermined part of the wall; 64¼ feet of the old wall were rebuilt and it was extended northward 43¾ feet, making its present length about 434 feet; the new work was 5½ feet wide on top and from 1 to 2 feet higher than the old wall.

In 1836–1840 a canal was cut through Great Marsh, extending from a bend in the river near its mouth into the bay outside, with the object of "facilitating commercial intercourse between the port of Saugatuck [now Westport] and the city of New York," by cutting off the natural channel around Cockenoe Island, saving a distance of from 4 to 5 miles between the points named. The canal was made 68 feet wide at high water, 44 feet wide at the bottom, and was 1,350 feet long. The material removed was piled up on the banks. Part of the east side was protected by a dry wall of small stones extending out into the bay and terminating in a beacon.

The present condition of the breakwater on Cedar Point is fair. The canal was used more or less for 10 years, but gradually filled up, and for 40 years past has been of little use except for the smallest vessels light loaded. At either end it is nearly bare at low water, with an average depth of 1 to 2 feet inside.

In 1883 an examination of this harbor was made in pursuance of the river and harbor act of August 2, 1882. The officer in charge recommended that the canal be abandoned and that a survey be made to determine the cost of excavating a channel 4 feet deep up to the village of Westport, as being an improvement worthy to be made, provided it could be done at reasonable cost. A survey was made in accordance therewith, and an estimate of $36,000 submitted for such a channel to

be 100 feet wide, including removal of a few bowlders in and near the channel (see Annual Report of the Chief of Engineers for 1884, Part II, page 675).

February 4, 1886, a report was made by the officer in charge, forwarding a petition of citizens of Westport to the honorable Secretary of War, of which the following is a copy:

To the honorable the SECRETARY OF WAR,
Washington, D. C.:

We, the undersigned, would respectfully place before you the following facts:

From the settlement of Westport, Conn., a channel has existed through what is known as the Great Marsh, in said town, and it is the shortest entrance into the harbor of Westport by from 4 to 6 miles. In 1836–1839 this channel was improved by the United States Government. In 1882 a survey of the harbor of Westport was ordered, with a view to its further improvement.

The reports of the engineer officers in charge did not take up the question of the improvement of the channel through the Great Marsh, but only that portion of the harbor lying above the railroad bridge across said harbor.

The estimated cost of obtaining a 4-foot channel 100 feet wide from said railroad bridge to the head of navigation, a distance of about 1¼ miles, was $36,000.

Your petitioners would respectfully represent that the growing manufactures on the Saugatuck River below the head of navigation have lately changed the necessities of said harbor existing at the time of said survey, and they believe that it would be more advantageous to the commerce of Westport Harbor to open the channel through the Great Marsh to a depth of 4 feet at low water and a width of 100 feet, which would probably cost from $10,000 to $15,000, than to expend $36,000 on the upper navigation of the harbor.

We therefore pray that this question may be investigated as soon as possible, believing it to be of vital importance to the interests of our commerce.

Dated at Westport, January 9, A. D. 1886.

The officer in charge states that reopening the canal—

Would shorten the sailing distance to New York, would give vessels plying between New York and Westport the protection of the Norwalk Islands during passages in stormy weather, and would save them the delay now caused by beating up the narrow and crooked channel through which the Saugatuck River now empties into the Sound.

The estimated cost of this work is $18,000. I recommend the matter for favorable consideration.

From these reports it appears that a difference of opinion has existed as to the importance of the improvements desired, *i. e.*, whether the natural channel should be first improved by dredging and removal of rock obstructions, or the deepening and widening of the canal (a short cut through Great Salt Marsh) should be first undertaken.

Undoubtedly those who signed the petition of 1886 would like to see the canal reopened, as asked by the petition; but, as far as I am able to ascertain, nearly all of them would prefer the improvement of the natural channel, if limited to a choice between the two. The reasons are obvious from a comparison of the results to be obtained and of the estimates of costs.

Reopening the canal would shorten the distance to westward ports by about 4 miles; nearly all the commerce goes to and comes from the west; for sailing vessels going west with southeast wind it would save that distance to be made against the wind. In this way it would reduce somewhat the average time of trips to and from the west, and consequently the average cost of such trips, but the reduction would be so small that it is doubtful whether the rates of freight would be lowered by it. The most important benefit which would ensue from reopening the canal is the saving of the danger of 8 miles sailing in the open Sound.

Improving the channel would, it is believed, materially reduce freight rates. Ten years ago coal from New York to Westport cost 75 cents per ton, about the same as to Norwalk. Two or three vessels have been

wrecked on the rocks in the channel, making shippers afraid to send there, and present rates are from $1.10 to $1.25 per ton, and many shippers refuse to send there at all; in the mean time Norwalk rates are about as formerly. It is believed that if the channel were free from rocks rates would return nearly or quite to the old basis. It is believed that if the channel were deepened to 4 or 6 feet up to Westport, the saving of time now lost in waiting for tides would be greater than any probable saving from use of the canal. The mean rise of tide in the Saugatuck River is 7 feet.

The improvement of Westport Harbor is not a new work, and the necessity for it is greater now than when former appropriations were made. I am of the opinion that the harbor or river is worthy of improvement. No further surveys are needed for the purpose of estimates, which can be sufficiently made from the maps of surveys of 1872 and 1883.

A channel 100 feet wide and 6 feet deep at mean low water would require removal of ten or twelve bowlders from the lower part of the river between Westport and the railroad bridge, and dredging from the wagon bridge at Saugatuck up to Westport; a very little dredging to obtain full width would also be required below the wagon bridge. The amount of bowlders to be removed can not be accurately determined, as they are partly below bottom.

Removal of bowlders, approximate cost	$1,400
Dredging 135,000 cubic yards, at 25 cents	33,750
Contingencies, etc., about 15 per cent	4,850
Total	40,000

To which should be added estimated average annual cost of maintenance, $2,000.

With a less amount the channel could be improved in this way so as to secure a proportional benefit; the cost of making a 4-foot channel 60 feet wide up to Westport would be less both in rock removal and in dredging; estimated cost, about $10,000.

Enlarging the canal, to make a channel 100 feet wide and 5 feet deep at mean low water, would require dredging for about 3,000 linear feet, nearly half the distance being in the "Great Marsh." The outer part, about 1,200 feet long, would be exposed to storms, and without some protection would probably fill up rapidly; but it is believed that it would be more satisfactory and economical in the end to redredge this part as frequently as necessary (perhaps every other year) than to undertake any protection, which would not obviate but only reduce the frequency of dredging.

Ninety-two thousand cubic yards of sand and gravel, at 20 cents per yard	$18,400
Contingencies, etc	2,600
Total	21,000

To which should be added the cost of repairs and maintenance, estimated at an annual average cost of $2,500.

The improvement of the natural channel should precede any work on the canal or short cut.

Accompanying this report is a statement of commerce of the Saugatuck River, furnished by parties interested in the improvement of the river.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

LETTER FROM MR. MARK L. FILLEY.

THE SAUGATUCK IRON WORKS COMPANY,
Saugatuck, Conn., January 3, 1891.

MY DEAR SIR: I have your two letters in relation to the amount of commerce passing on the Saugatuck River, and I have been delayed answering from the fact of the time it took to gather the statistics. Even now I find a very large amount overlooked, a great deal going up our valley and being distributed so broadcast as to prevent any kind of compilation. Our Saugatuck River is a large stream in itself, and not a set back caused by tide, and the time is not far distant when its shores must be lined with factories, now only waiting to be built if we can get the appropriation sought. * * *

We have a propeller running between here and New York whose trips would be doubled were the facilities sufficient for its doing so.

Very truly yours,

MARK L. FILLEY,
President.

The following statistics are abridged for a detailed statement of the receipts and shipments of twenty-seven different corporations, firms, or individuals:

	Tons.
Coal	7,075
Lumber	1,900
Brick	200
Supplies, manufactured goods, and miscellaneous merchandise	13,799
Total	22,974

D 33.

PRELIMINARY EXAMINATION OF MATTITUCK BAY, SUFFOLK COUNTY, NEW YORK, FOR BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
New York, December 8, 1890.

GENERAL: I have the honor to submit the following report on a preliminary examination of Mattituck Bay, Suffolk County, New York, for breakwater, made in pursuance of the river and harbor act approved September 19, 1890.

This bay is the enlargement at its head of a tidal inlet on the north side of Long Island, having its outlet on Long Island Sound, and is situated 82 miles east of New York City.

The following description of the inlet and bay is given by Mr. Henry N. Babcock, assistant engineer:

The channel from Mattituck to Long Island Sound is a tidal creek nearly 2 miles long. About 1¼ miles below the village a tide mill and dam close the channel and a highway crosses over the dam; the tide gates are usually kept closed so as to make slack high water in the upper basin; when open, the highway practically closes the channel so that a rowboat can not pass under when the tide is more than half up. Below the tide mill the creek runs nearly straight towards the Sound for over one-fourth mile, then turns to the southwest and runs about parallel with the beach for perhaps 800 to 1,000 feet, then turns northwest to the Sound. The outlet channel is said to change with every storm, varying sometimes 400 feet in a day.

The rise of tide above (south of) the mill dam is said to be from 1 to 2 feet, according to whether the gates are open or not; the tide in that part of the Sound is about 4 feet. I was told that the flood tide in the Sound at that point is mostly an eddy tide with eastward current—that the current sets east for 9 hours and west for 3 hours.

The current in the creek at and near the mouth is very strong—at its strongest it must exceed 4 miles per hour.

At the entrance the channel is narrow and generally crooked; its available depth is about 2 feet at low water.

Above the mouth the low-water depth ranges from 4 to 8 feet up to the tide mill; the creek is generally narrow, not over 150 feet wide. At the mill-dam. on either side, there is a small shoal. Above the mill the depths at high water for the first three-fourths mile are from 5 to 7 feet and the channel is crooked and often narrow, though the creek itself is wider; in the upper half mile the channel is broad and fully 7 feet deep at high tide. Above the dam depths at present low tide are only 1 to 2 feet less than at high tide; if the dam were removed the low-water plane would probably be lowered a foot or more.

The bottom at the entrance is hard sand; in the creek it is soft, muddy sand, or mud.

I made a personal examination of the locality in October, 1890, and am of the opinion that it is practicable to make an improvement which will make the inlet available at all stages of the tide for vessels of light draft, say 6 feet.

The people interested desire such an improvement as will enable vessels to enter the inlet at all times and reach the head of practicable navigation at Mattituck village, which is the center of quite a large farming district supplying products for the New York and Brooklyn markets, and now entirely dependent on the Long Island Railroad. It is alleged that the freight charges on this road are so high and the service so inadequate that the development of the region in this vicinity is greatly retarded. These matters are very fully set forth in the accompanying communication from Mr. J. M. Lupton, of Mattituck.

In addition to the local advantages, it is claimed that an improvement of Mattituck Inlet would afford a harbor of refuge for vessels navigating Long Island Sound, there being no harbor on the south shore east of Port Jefferson to Plum Gut, at the end of Long Island, a distance of 50 miles. In this connection attention is called to a report on breakwater at Horton Point, made in pursuance of the river and harbor act approved July 5, 1884, and published in the Annual Report of the Chief of Engineers for 1885, page 701. The report was favorable to the construction of a harbor of refuge at some point on the Long Island shore between Huntington Harbor and Plum Gut.

While I do not believe that a breakwater at the entrance of Mattituck Bay can be constructed at any reasonable cost, to afford a harbor of refuge for all vessels navigating the Sound, the inlet may be so improved as to afford safety to a large class of small vessels, in addition to meeting the local wants. Such an improvement would consist in the construction of two piers at the outlet to prevent the movement of sand and shingle, and dredging to obtain the required depth inside. A harbor here for light-draft vessels would be of very great value if it should ever be decided to construct a large harbor of refuge in the vicinity. I am of the opinion that this harbor is worthy of improvement, provided that it can be done at a reasonable cost. The data available are insufficient for an approximate estimate, and a survey will be necessary at a cost of $400. Such a survey would be useful in any case.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[Fourth indorsement.]

ENGINEER OFFICE, U. S. ARMY,
New York, August 5, 1891.

Respectfully returned to the Chief of Engineers.

From the data obtained from a further examination, the following is estimated as the cost of an improvement which will give a channel 7 feet deep at low tide from Long Island Sound up to the tide mill, to be 100 feet wide at the entrance, and thence to the mill to be 80 feet wide: the entrance channel to be secured by building parallel jetties on either side extending from the shore out to the 9-foot curve in Long Island Sound, and after that is done, the channel to be extended from the mill to the village, making it 7 feet deep at high water and 80 feet wide, a total length of channel of 11,100 feet, about 8,000 feet of which require dredging.

The jetties should be 400 feet apart with cross section 5 feet wide on top, which is 5 feet above high water, with inner slope of 1 upon 1, and outer slope of 1 upon 1½.

West Jetty, 10,504 tons riprap, at $2	$21,008
East Jetty, 9,116 tons rip-rap, at $2	18,232
Dredging: Entrance channel, 19,500 cubic yards, at 40	7,800
Thence to Bailey's dock, 23,000 cubic yards, at 30	6,900
Thence to tide mill, 41,600 cubic yards, at 30	12,480
Thence to village, 30,800 cubic yards, at 20	6,160
	72,580
Contingencies, supervision, etc	10,420
Total estimated cost	83,000

In view of this and the present and prospective demands of commerce, I am of the opinion that Mattituck Bay is worthy of improvement. A tracing showing the bay and proposed improvements will be forwarded as soon as practicable.

No further examination or survey is needed for making estimate of cost.

D. C. HOUSTON,
Colonel, Corps of Engineers.

STATEMENT OF MR. J. M. LUPTON.

Commercial statistics of Mattituck, New York, for 1 year, November 1, 1889, to November 1, 1890.

FREIGHT RECEIVED BY RAIL.

		Quantity.	Value.
Fertilizer and fertilizing material	tons	1,449	$46,895
Coal	do	921	5,141
General merchandise	do	575	42,602
Grain, flour, and feed	do	360	10,530
Provisions (not otherwise specified)	do	291	34,250
Lumber	feet	931,930	31,050
Other building material	tons	229	4,290
Farm implements and machinery	do	166	16,750
Household goods, furniture, miscellaneous	do	1,381	92,628

Commercial statistics of Mattituck, New York, etc.—Continued.

SHIPMENTS BY RAIL.

		Quantity.	Value.
Potatoes and turnips	bushels	122,000	80,485
Green vegetables	barrels	42,750	107,000
Grain and other provisions	tons	398	23,880
Garden seeds	pounds	46,176	27,705
Vegetables in salt or brine	casks	10,800	29,500
Canned goods	cases	16,500	54,500
Fertilizers	tons	225	7,875
Butter and dressed meat	do	118	27,275
Eggs	dozen	80,848	15,689
Miscellaneous	tons	2,349	152,750

RECEIPTS BY WATER.

Fertilizer	tons	345	8,625

SHIPMENTS BY WATER.

Potatoes, etc	bushels	12,000	8,400
Fertilizer	tons	27	945
Other farm products	do	2,000	15,500

The present population of Mattituck is about 1,500. In amount of revenue derived by Long Island Railroad it stands third on the main line. In amount and value of shipments of farm and garden produce it stands first among the stations on Long Island Railroad. Money collected by station agent at Mattituck is $45,000 per annum, which does not include shipments when freight charges are paid at destination, which represents the larger share of the traffic.

PROSPECTIVE COMMERCE.

High-freight rate and inadequate facilities for transportation have operated largely against the rapid development of this section in the past. The growing of vegetables for market is an industry of recent growth and rapidly increasing. The canning business, representing the past year an output of 16,500 cases of canned goods, is to be doubled here the coming season, steps having been already taken to that end. The pickling business also, now putting up 10,800 casks of pickled vegetables, will undoubtedly be largely increased in the near future.

The soil and climatic conditions of this section are all that could be desired for growing vegetables to perfection, and the amount and value of these shipments, which represent the larger part of the traffic, might easily be doubled; but the farmers of this section, with the greatest market of the country but 80 miles away, pay as much or more to reach that market as their competitors who are hundreds of miles distant, and secure at best a most unsatisfactory service—the freight trains frequently being several hours late, a matter which has caused a loss of thousands of dollars yearly to our farmers by shrinkage in market values. The improvement in question is looked upon as the best and only available means of securing good service and fair rates to this section, and it is confidently asserted that if water communication can be established here it will accommodate a traffic greater than that at present shipped from and received at the railroad station, not only from the fact that the development of our natural resources must largely increase the tonnage, but it will draw from nearly double the area of territory by reason of the facilities it offers.

A few examples will suffice to show the actual gain to shippers of this section from this improvement. Potato shipments, 122,000 bushels, pay freight at 6 cents per bushel in car lots, or 7½ cents for less quantity. From this point by water potatoes could be readily freighted at 4 cents per bushel, and by reason of the increased territory which would find an outlet here the shipments would probably reach 200,000 bushels, upon which a saving of about 2½ cents per bushel would be effected, or a yearly saving to the farmers of about $5,000. Upon 1,500 tons of fertilizer from New York factories the saving would be about 90 cents per ton, or $1,350. Upon about 500 tons received from Connecticut and Eastern factories the saving would be $1.15 per

ton, or $575, making an annual saving to farmers in freights on this item of about $1,925. Upon green vegetables, shipments average 40,000 barrels per year, and the saving in freight is estimated at 12 cents per barrel, or $4,800 per year. And upon all traffic there will be a large gain, which will secure to this community a large return from the expenditure asked of the Government for this work. Aside from the benefits accruing to this immediate locality as a direct result of this improvement we ask your consideration of the following points, all of which we believe have an important bearing upon this matter.

I. As a place of refuge for vessels passing through Long Island Sound. Between Port Jefferson and Orient Point, a distance in a straight line of 58 miles, there is no inlet which will bear any comparison to the one in question, and this bay is the only point where a harbor can be established at moderate cost. The improvement contemplated, while it would not be sufficient to admit the larger vessels, would be of such a character as to afford a refuge for the smaller class of vessels, which are most in danger and must prove of immense advantage to the coastwise traffic of the sound.

II. As a means of communication between the east end and the north shore of Long Island. A steamboat line, which upon the completion of said improvement would be at once established, would furnish a connection between Port Jefferson and other points on the north shore and the east end of the island, effecting a great saving in distance and establishing valuable commercial relations between the points mentioned. For example, passengers and merchandise from Port Jefferson to Mattituck by rail travel a distance of 98 miles; by water the distance would be 30 miles. Port Jefferson to Riverhead by rail 81 miles; water, via Mattituck Bay, 39 miles. Port Jefferson to Greenport, rail 102 miles; water, via Mattituck Bay, 42 miles. And a great saving of distance and consequent expense can be made by this connection between all points upon the north shore branches of the Long Island Railroad and all points at the east end, a matter which can be readily understood by reference to any map of the island. The value of this connection, while necessarily a matter of conjecture, has been deemed of such importance, that two routes have been surveyed, with a view to building a railroad, which would probably have been built before but for the hilly and rocky country over which it must necessarily pass.

III. For the benefit of commerce between Long Island and Connecticut. The cities and towns of the Connecticut shore draw their supplies of farm produce largely from eastern Long Island, and thousands of bushels of potatoes, turnips, and other farm produce are carried yearly by vessel from New Suffolk and Jamesport, on Peconic Bay, to the Connecticut towns, the largest market being found in the city of New Haven. The value of proposed improvement to such commerce can readily be seen when we consider that New Haven is from New Suffolk 75 miles, from Jamesport 83 miles, while from Mattituck the distance is but 26 miles, and the source of supply from the farms would be nearer a dock on Mattituck Bay than those of either Jamesport or New Suffolk. Packet service has frequently been maintained between this place and Connecticut ports, but has always been difficult and uncertain, owing to the character of the inlet. The improvement of the channel, however, would open the way to regular and important commercial relations between the points indicated.

IV. For the benefit of the neighboring villages. The most productive section of Long Island lies between Riverhead and Orient Point. With the exception of the market gardens in the immediate neighborhood of the large cities, there is probably no section in the State which produces a greater amount of farm produce upon the same area. The villages of Greenport and Southold, at the east end, secure special rates by rail because of a steamboat connection to New York, while the intermediate villages of Peconic, Cutchogue, Mattituck, and Jamesport are obliged to pay higher rates for the same service over a shorter distance. The freight service of the Long Island Railroad has proven entirely inadequate to the demands upon it, and during the busy season freight trains have been regularly 8 to 12 hours behind time. Thousands of dollars have been lost yearly to the farmers of these villages because of these delays, their perishable goods arriving at market in unsatisfactory condition, and too late to secure the best results. The improvement to the harbor at Mattituck and establishment of water communication from here will be of great advantage to the other villages as well, because Peconic on the east and Jamesport on the west are neither more than 5 miles distant, and the farmers can easily reach this point. This improvement, therefore, will render them to a great extent independent and in a position to secure better rates.

V. For the benefit of oyster culture in this bay. We have, according to the opinion of an expert who has made an examination, 250 to 300 acres of very superior oyster bottom, capable of producing 150,000 bushels yearly, valued at $250,000. Oysters from this bay have always been of a very superior quality and sell at the highest price in market, but, by reason of the small amount of salt water which reaches its headwaters under present conditions, their cultivation has never been practicable.

The improvement in question, however, would prove an adequate remedy, and result in the establishment of a new and valuable industry. We refer you on this point to Captain J. M. Monsell, Greenpoint, N. Y.

VI. For the advancement of real-estate values. This bay has a shore front of nearly 7 miles, so situated as to offer superior advantages as a place of summer residence for city people, and has only to become known to be appreciated. The improvement in question will go a long way toward bringing these shores to the attention of people in search of such opportunity, and there can be no doubt of largely increased real-estate values, with consequent increase of assessments and increased revenue from taxation not only from the source indicated, but from the fact that every industry centering here is bound to be strengthened by a work which will increase the productiveness and add largely to the material welfare of this community and whose influence will be felt for several miles around.

Finally, we desire to call particular attention to the fact that while the headwaters of this bay reach the very center of this village, which is of itself the center of one of the most productive sections of Long Island, its outlet is directly into Long Island Sound. By reason of this position it is reached from the farms as handily as the railway station, while to reach any shipping port on Peconic Bay an extra cartage of at least 2 or 3 miles is necessary. At the same time the outlet into the sound obviates the necessity of doubling the eastern extremity of the island; a serious drawback to all water traffic at present.

We invite the fullest investigation of all statements made here, and for that purpose will furnish you with every facility at our command, and will thank you for a most careful consideration of this matter in all its bearings.

For the people of Mattituck, L. I.

By J. M. LUPTON.

D. C. HOUSTON,
Colonel of Engineers.

D 34.

PRELIMINARY EXAMINATION OF STAMFORD HARBOR, STAMFORD, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York, February 10, 1891.

GENERAL: I have the honor to submit the following report upon preliminary examination of Stamford Harbor, Stamford, Conn., made in pursuance of the river and harbor act approved September 19, 1890.

A survey of this harbor was made in 1883 in pursuance of the river and harbor act of August 2, 1882. The reports on preliminary examination and survey were published in the Annual Report of the Chief of Engineers for 1884, pages 670–673. The project submitted called for a channel 80 feet wide and 5 feet deep at mean low water to the head of navigation in Stamford, at an estimated cost of $20,000. There has been expended nearly $15,000, and the appropriation of $5,000 by the river and harbor act approved September 19, 1890, will complete the original project.

The mean rise of tide in Stamford Harbor is nearly 8 feet, and the bottom soft (on the surface), so that the high-water channel, which is from 400 to 2,500 feet wide or more, can be and is utilized. Harbor lines have been established in the upper part of the harbor by authority of the Hon. Secretary of War; these were located so as to preserve the high-water channel.

It is now desired by parties interested that the low-water channel be widened and deepened, and that the lower portion of the harbor be enlarged and protected by breakwaters, so as to afford anchorage ground and a harbor of safety.

This report has been delayed owing to difficulty in obtaining information as to the additional improvements desired and statistics as to the

amount of commerce to be benefited. I am of the opinion, however, that in view of the present and prospective demands of commerce the harbor is worthy of improvement. It is not a new work, and the location of the town of Stamford, with a population of about 18,000, leads me to believe that the further improvement of the harbor will develop an increase of business by water. The improvement of the lower part of the harbor would also add to the security of navigation in Long Island Sound.

A survey is needed to prepare plans and estimates, the cost of which will be about $400.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SURVEY OF STAMFORD HARBOR, STAMFORD, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York, September 16, 1891.

GENERAL: I have the honor to submit the following report on the survey of Stamford Harbor, Connecticut, directed by letter of the Chief of Engineers, dated February 12, 1891, in pursuance of the river and harbor act approved September 19, 1890.

The accompanying report of Mr. Henry N. Babcock, assistant engineer, gives a description of the harbor and details of the desired improvements.

The original depth to the wharves at Stamford was less than 3 feet at mean low water. Under a project adopted in 1886 appropriations amounting to $20,000 have been made and the channel has been deepened to 5 feet at mean low water, with width of 75 feet or over, completing the project. This channel is not sufficient to accommodate the growing commerce of Stamford; it is desired to have it deepened to 7 feet at mean low water and widened to 150 feet, and to have the basin at the head of the harbor dredged out to the established harbor lines. The estimated cost is as follows:

Dredging to make the channel 150 feet wide and 7 feet deep at mean low water:		
190,000 cubic yards, at 21 cents	$39,900	
Contingencies and supervision about	6,100	
		$46,000
Dredging to make the basin between harbor lines at the head of harbor 7 feet deep:		
150,000 cubic yards, at 28 cents	42,000	
Contingencies and supervision about	7,000	
		49,000
Total estimated cost		95,000

In addition it is desired that the outer harbor be protected by a breakwater extending about 1,800 feet southwesterly from Shippan Point, at an estimated cost of $77,000, which would shelter from easterly storms an anchorage of about 50 acres, with 12 feet depth at mean low water.

The dredging in the upper harbor is the more urgently needed, and should be the first improvement undertaken.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. HENRY N. BABCOCK, ASSISTANT ENGINEER.

ENGINEER OFFICE, U. S. ARMY,
New York City, September 15, 1891.

COLONEL: I have the honor to submit the following report upon the results of the survey of Stamford Harbor, Connecticut, authorized by the river and harbor act of September 19, 1890, and made under your direction in July, 1891, together with plans and estimates of cost of the improvements desired, and a brief statement of the amount of commerce to be benefited by such improvements.

GENERAL DESCRIPTION OF HARBOR.

The harbor is on the north shore of Long Island Sound, nearly 6 miles east from the New York State line, and consists of a bay extending about a mile inland with a narrow tidal arm (the mouth of Mill River) reaching up to Oliver Street Bridge in Stamford; under this bridge is a dam, which limits possible navigation.

Stamford light-house is at the south end of a middle ground which extends from the entrance of the bay nearly to its head and connects with the west shore by a broad shoal. The entrance channel lies between the light-house on the west and Shippan Point on the east; its depth decreases from 18 feet at the entrance to 6 feet about half-way up the bay; thence it originally decreased to 3 feet or less at the wharves in Mill River, but under recent Government appropriations it has been made 5 feet deep at mean low water and from 75 to 100 feet wide. The bay opens to the southward, and is directly exposed to storms from southeast to southwest; northeast storms drive a heavy sea into the outer part of the bay, making it a rough anchorage, only slightly sheltered by a shoal of sand and bowlders extending out from Shippan Point. The middle ground, with depths of from 2 to 6 feet at low tide, affords but little protection from the southwest.

The bottom in the channel is mud for the most part, with sand on either side; near the head of the harbor the mud is from one-half foot to 2 feet thick, overlying gravel, and in one place a very hard bed of clay and stones; this bed, as far as discovered, appears to extend across the harbor near the Lumber Yard Wharf; it is about 200 feet wide, and with this exception there is no part of the channel difficult to dredge.

About one-third of a mile east of Mill River is "the canal," a private channel said to be 6 feet deep at low water and 60 or more feet wide. It extends up nearly a mile through the bed of an old marsh creek and divides the water commerce of Stamford with Mill River into roughly equal parts

PREVIOUS WORK BY THE UNITED STATES.

Under the river and harbor act of 1882 a survey of the harbor was made, the report on which is printed in the Annual Report of the Chief of Engineers for 1884, Part I, pages 670 *et seq.* With this report a project was submitted for dredging a channel 5 feet deep at mean low water and 80 feet wide up to the head of the harbor at an estimated cost of $20,000. The full amount of the estimate has been appropriated and the channel has been dredged essentially as designed. Harbor lines have been established in the upper part of the harbor by the Secretary of War under provision of the river and harbor act of 1888.

FURTHER IMPROVEMENT DESIRED.

It is found that the present channel is insufficient as to depth and width, and it is desired now that it be made 7 feet deep at mean low water and 150 feet wide, and that the basin in the upper part of the harbor be deepened within the established harbor lines.

It is also desired that a harbor of refuge be established at the mouth of the harbor by building a breakwater southwesterly from Shippan Point and another one along the south part of the middle ground to afford shelter to local commerce and to the general commerce of Long Island Sound.

PLANS AND ESTIMATES OF COST FOR CHANNEL IMPROVEMENTS.

For a channel 150 feet wide and 7 feet deep at mean low water with a basin between the harbor lines at the head of the harbor.

The total length of such a channel from the 7-foot curve to the head of the harbor would be about 7,000 feet, and it would require dredging about 190,000 cubic yards. One quarter of this material would be rather hard, and a fair average cost would be 21 cents per cubic yard.

The total length of the basin at the head of the harbor would be 1,300 feet, with an average width of 280 feet outside the channel, requiring the excavation of 157,000 cubic yards of sand and gravel, with a few large bowlders. It would cost about 28 cents per cubic yard.

Dredging in the channel, 190,000 cubic yards, at 21 cents per cubic yard	$39,900	
Dredging in the basin, 150,000 cubic yards, at 28 cents per cubic yard	42,000	
		81,900
Contingencies, supervision, etc., about 15 per cent		13,100
Total estimated cost		95,000

PLANS AND ESTIMATES FOR A HARBOR OF REFUGE.

This is desired more for the benefit of general commerce in Long Island Sound than for local commerce, to which it would be incidentally a convenience, but not a necessity. For the large number of barges traversing the sound, for yachts, fishing boats, and smaller boats generally Stamford Harbor would, if sufficiently sheltered, offer a refuge more convenient than any near by for a small number of vessels of moderate draft; but the natural conditions are such that a harbor of any considerable size could not be obtained without large outlay. What is desired is a harbor of not less than 50 acres area with depth of 12 feet at mean low water. To protect this from easterly storms it would be necessary to build a breakwater extending southwesterly from Shippan Point to the 15-foot curve, a distance of 1,800 feet, estimated to cost about $77,000; to protect it from the southwest would require a breakwater on the middle ground about 1,800 feet long, extending about north by west and south by east, estimated to cost about $81,000. This would still leave an entrance channel of 1,500 feet wide—practically the full width of the harbor—exposed to southerly storms; and the cost of a breakwater to protect the harbor from this side would be not less than $120,000.

Thus to completely shelter a small harbor at this point would cost over $250,000, but to shelter such a harbor from easterly storms, which in this part of the Sound are the most severe and most frequent, would require only $77,000. It is believed that the latter estimate is the only one which should be at present considered.

COMMERCE TO BE BENEFITED.

The commerce of Stamford Harbor, exclusive of that via "the canal," was given as follows in the Annual Report for 1891:

Arrival and departure of vessels.

[Draft 5 to 12 feet; tonnage 10 to 375 tons.]

Steamers	170
Sailing vessels	370
Barges	160

Freight received and shipped.

Articles.	Tons.	Value.
Coal	16,000	$80,000
Lumber and baryta	20,000	40,000
Miscellaneous	14,000	120,000
Total	50,000	240,000

The above figures show an increase in tonnage of freights over those reported for 1889 of 3,890 tons.

All of this would be benefited by the channel improvement.

The commerce which would be more or less benefited by a harbor of refuge at Stamford includes the greater part of such passing freight as is carried in vessels and barges of 9 feet draft or less. Its amount is very large, but no figures are obtainable from which it could be even roughly estimated.

SUMMARY.

To make the present channel 150 feet wide and 7 feet deep at mean low water would cost about $46,000; to dredge out the basin in the upper part of the harbor would cost about $49,000; total, $95,000.

To make a harbor of refuge sheltered against storms from any easterly quarter would cost $77,000.

It is believed that the local preference would be greatly in favor of improving the channel if only one of the projects were to be adopted.

Very respectfully, your obedient servant,

HENRY N. BABCOCK,
Assistant Engineer.

Col. D. C. HOUSTON,
Corps of Engineers, U. S. A.

D 35.

PRELIMINARY EXAMINATION OF COS COB OR MIAMUS RIVER, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York, January 8, 1891.

GENERAL: I have the honor to submit the following report on preliminary examination of Cos Cob Harbor, Connecticut, made in pursuance of the river and harbor act approved September 19, 1890:

This harbor is situated on the north shore of Long Island Sound about 34 miles by water from the Battery, New York City. It has a high-water area of three-quarters of a square mile up to the village of Miamus, the head of navigation. The low-water channel has a depth of 8 feet at the entrance to the harbor at mean low water and a depth varying from 8 to 17 feet, as shown by the Coast Survey Charts, for a distance of 5,000 feet above the mouth, with a width varying from 350 to 180 feet over 6 feet deep at mean low water. Above this point to Miamus, a distance of 6,000 feet, the low-water channel gradually diminishes in depth, the harbor being nearly bare at low water above the railroad bridge, in which there is a draw. The mean range of tides is 7.4 feet.

This harbor is well sheltered from storms in every direction.

It is desired by parties interested that the low-water channel be improved so as to give a width of 150 feet and a depth of 6 feet to the railroad bridge and a width of 100 feet and same depth from the bridge to Miamus. The interests to be benefited are given in the accompanying statements.

This harbor, like others on the north shore of Long Island Sound, provides water transportation in direct competition with the railroad along the coast. Its improvement would increase the safety of navigation for a large class of vessels navigating the Sound.

The estimated cost of the improvement asked for is as follows, provided no rock is found:

Dredging 160,000 cubic yards, at 20 cents	$32,000
Contingencies	4,000
Total	36,000

In view of the present and prospective demands of commerce and the comparatively small cost of the improvement, I am of the opinion that the harbor is worthy of improvement. A survey is needed to determine the character of the bottom, the cost of which is estimated at $50.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Commercial statistics for Cos Cob Harbor, Connecticut, for the first 9 months of the current year—January 1 to September 30, 1890.

The amount of freight received by water was:

		Quantity.	Value.
Coal (about)	tons	12,600	$65,000
Lumber (about)	feet	300,000	15,000
Other building materials (lime, cement)	bbls	4,000	9,000
Miscellaneous	tons	6,000	30,000

The amount of freight shipped by water was:

		Quantity.	Value.
Apples	bbls	65,000	$100,000
Potatoes	do	42,000	105,000
Hay	tons	200	30,000
Other vegetables and products	bbls	100,000	150,000

The number of vessels which entered the harbor during the above 9 months was (counting each trip of boats entering often), including yachts, freighters, and those using the ship-yards—

Steamers (about)		300
Sail vessels (about)		2,000
Barges (about)		500
Tonnage of above boats	tons	3 to 80
Draft of above boats	feet	2 to 9

The number of vessels which make regular or frequent trips to and from Cos Cob Harbor is 1 steamer and 5 schooners.

The population of the village of Cos Cob, including Mianus and Riverside, is about 3,000. The harbor is used as a water outlet by a surrounding country of about 200 square miles, including a total population of from 10,000 to 12,000

FREDERICK BELTZ.

ALEXANDER S. WILLIAMS.
GEORGE I. TYSON,
Commodore Riverside Yacht Club.

PETITION.

The undersigned, real estate, vessel owners, ship builders, and residents of Riverside, Mianus, and Cos Cob, in Fairfield County, Connecticut, and others interested in improving the harbor by deepening and widening the channel way of Cos Cob Harbor and Mianus River, in the said county and State, respectfully petition:

That the said channel be improved so as to give a channel way in width of at least 300 feet, and a depth of at least 6 feet at low water. The present width of said chan-

nel is about 75 feet, and the depth thereof about 7 feet in the middle thereof at low water.

The widening and deepening of said channel is petitioned to begin at the harbor's mouth and to continue north to Mianus.

The commercial and shipping industries of said harbor demand the immediate relief and improvement herein prayed, since there is imminent danger of the channel diminishing in its width and depth by reason of garbage dumped in Long Island Sound being carried up the harbor with the tide, and also from the mud deposits on the river's bed being washed down with the current thereof.

There are at present three regular lines of packets carrying merchandise between here and New York City twice in each week, in addition to the canal boats, coal barges, and other vessels coming in with their respective cargoes with more or less regularity.

The river and harbor petitioned herein to be improved is an arm of Long Island Sound, and can be readily restored into being an important and safe anchorage for vessels of all classes navigating the Sound in all kinds of weather.

The importance and beneficial result of such improvement are more specifically hereinafter set forth:

A vessel can put into this harbor and river in any storm, with the wind from any direction, and when in will be completely land locked. The prevailing winds in the fall, winter, and spring are east and northeast, and frequently very severe, and vessels navigating Long Island Sound are often compelled to put in on the south shore of the Sound, because of the lack of sufficient good and safe harbors on the north shore thereof (the north shore of the Sound making a "lee shore," and therefore preferable).

The harbor and river when improved as herein petitioned will avoid the necessity of east-bound vessels from putting back to City Island or other points for an anchorage, thus saving a distance of between 20 and 25 miles in heavy weather. Vessels can easily enter into or depart from this harbor, when so improved, no matter what quarter the wind is from.

With slight exception, the harbor and river bed is soft mud, and your petitioners represent and believe that an appropriation and judicious expenditure of $10,000 to $12,000 would make this one of, if not, the best, safest and most available harbors on the north shore of Long Island Sound, between New York and New Haven.

The commercial, shipping, and ship-building industries of this harbor are already important, and if improved as herein petitioned will rapidly increase, and the general public interest be greatly served.

[Since making the petition there has been erected on the banks of the river at Mianus a large brush factory, all the shipping and receiving of goods of which will be done by water.

Negotiations are now being conducted for the purchase of a number of building sites for manufacturing purposes, predicated on the expectation and hope of a favorable consideration of this petition, and in this the parties are encouraged by the fact that a survey is about being made.

Before the filling up of the channel the ship yard at Cos Cob had all it could do in the way of overhauling and repairing vessels from various ports; since that, however, its operations have been confined almost entirely to the oyster fleet and the vessels of the home port. If the improvement petitioned for was made all this trade would soon find its way back.]

No appropriation for any improvement of any kind whatsoever in this locality has ever been heretofore petitioned for or made.

To the Senate and House of Representatives
of the United States of America.

LETTER OF MR. FREDERICK BELTZ.

NEW YORK, *November 7, 1890.*

DEAR SIR: Replying to your favor of October 21, 1890: The foregoing, with the exception of the matter contained between brackets on this page is a copy of the petition to Congress on which the survey was directed to be made, and has been added, part as new matter and part to more fully cover the requirements of the act, a copy of which you so kindly sent me with your favor of October 21, instant.

It will give me great pleasure to have information of your visit, that I may arrange to have a committee of citizens of the place to meet with you and point out with greater particularity and detail the necessities of the improvement asked for.

Very respectfully,

FREDERICK BELTZ.

D. C. HOUSTON,
Colonel of Engineers.

SURVEY OF COS COB OR MIAMUS RIVER, CONNECTICUT.

ENGINEER OFFICE, U. S. ARMY,
New York City, July 31, 1891.

GENERAL: I have the honor to submit the following report on survey of Cos Cob or Miamus River, Connecticut, directed by your letter of January 9, in pursuance of the river and harbor act approved September 19, 1890:

My report on preliminary examination dated January 8, 1891, gives information as to the commercial importance of the locality with such statistics as I have been able to procure, also an estimate of cost for the improvement desired, viz, a low-water channel from the mouth of the river up to the railroad bridge, 150 feet wide and 8 feet deep, and 100 feet wide and of the same depth from the bridge to the village of Miamus:

Dredging 160,000 cubic yards, at 20 cents	$32,000
Contingencies	4,000
Total	36,000

The object of this survey was simply to determine whether there was any rock or other material which could not be removed within the estimate. No such material has been found.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

D 36.

PRELIMINARY EXAMINATION OF PECONIC RIVER, SUFFOLK COUNTY, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, December 9, 1890.

GENERAL: I have the honor to submit the following report on a preliminary examination of Peconic River, Suffolk County, New York, made in pursuance of the river and harbor act approved September 19, 1890. This river empties into Great Peconic Bay at its western end, its length from the bay to Riverhead, the head of navigation, being $2\frac{3}{4}$ miles. With Peconic Bay and Long Island Sound it furnishes water communication to New York City and intermediate points. The depth of water in the river is not great enough for vessels of sufficient draft to make such navigation advantageous. A survey was made of this river in 1870, in compliance with the river and harbor act approved July 11, 1870 (Report of the Chief of Engineers for 1871, page 814). The project submitted contemplated a channel from the mouth up to Terry and Wells's Dock, 75 feet wide and 8 feet deep at mean low water, or 9 feet at mean high water, at an estimated cost of $32,818.50. Appropriations were made in 1871, 1872, and 1873, amounting to $25,000, and their expenditure resulted, as shown by a survey made in 1873 (Report of the Chief of Engineers for 1874, Part II, pages 271–275) in a channel about 55 feet wide and 6 feet deep at mean low water up to the mouth of Mud Creek; thence for a distance of 2,400 feet no work seems to

have been done by the United States, the survey of 1873 showing an available depth of 2.4 feet; thence going upstream, the dredged channel was 3,000 feet long, 25 feet wide, and 4 feet deep at mean low water (material being thrown over the side), extending to within 350 feet of the head of navigation, which 350 feet was subsequently deepened by citizens of Riverhead. No work has been done by the United States since 1873. The sum of $5,000 was appropriated by the State of New York about 1873, and was expended in 1874 in making a channel about 2,400 feet long, 25 feet wide, and 5 to 6 feet deep, connecting the Government channels of 1871 and 1873, the material being thrown on the side of the cut.

In pursuance of the river and harbor act of August 2, 1882, a preliminary examination and a survey of this river were made (Report of the Chief of Engineers for 1883, pages 681–684). The preliminary report states that "this improvement should not be considered a new work, as much has already been done under Government and State appropriations for its benefit." An estimate of $29,000 was submitted for dredging a channel in the upper part of the river from Colonel Island to Riverhead, a distance of about 7,000 feet, to be 50 feet wide and 4 feet deep at mean low water. I made a personal examination of the river in October, 1890. It appears that the original project of a channel 75 feet wide was never completed; and also that a large amount of material was deposited on the side of the cut instead of being towed away. The result of this and the narrowness of the dredged channel has been that much material has washed back and the channel shoaled, so as to be unavailable except for small vessels, no work having been done for 16 years.

What is now desired is a channel 75 feet wide and 6 feet deep at mean low water up to Riverhead, and a turning basin for steamers at the head of the channel. It is claimed that if such a channel is made a steamboat will run from Riverhead to New York City, in competition with the Long Island Railroad, upon which the people in this locality are chiefly dependent for the shipment of farm products and the receipt of supplies. I am informed that the rates of freight from Riverhead to New York, a distance of 73 miles, are greater than from Greenport, L. I., to New York, a distance of 94 miles, the reason being that there is regular water transportation from Greenport to New York and other points. I inclose copy of a statement of commercial statistics furnished by citizens of Riverhead. I believe the reasons for this improvement are much greater than when the former appropriations were made. This section of Long Island is peculiarly adapted to the cultivation of vegetables, which find a ready market in New York City and Brooklyn. I am informed that this production has greatly increased of late and that the increase would be greater were freight rates reduced.

I am, therefore, of the opinion that the river is worthy of improvement. Owing to the lapse of time since any work was done and the narrow channel which was made, it is probable that the cost of making the desired improvement will be nearly as great as if nothing had been done. The estimate for this is, approximately, $60,000.

A resurvey is needed for a more accurate estimate and location of turning basin, the cost of which would be $300.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

COMMERCIAL STATISTICS.

Commercial statistics for Riverhead, Peconic River, New York, for the first nine months of the current year—January 1 to September 30, 1890.

Amount of freight received by water—

	Value.
Coal, 1,000 tons	$5,000
Lumber, 300,000 feet	30,000
Other building materials	20,000
Miscellaneous	25,000
Amount of freight shipped by water—	
10,000 tons	100,000
Farming products, wood, etc	50,000

The amount of freight received by rail which would have been brought by water had the channel been 6 feet deep at low tide and 75 feet wide is estimated at —— tons, valued at $50,000, and such freight would probably consist of merchandise, lumber, coal, fertilizers, etc.

The amount of freight shipped by rail which would have been sent by water had the channel been 6 feet deep at low tide and 75 feet wide is estimated at —— tons, valued at $200,000, and such freight would probably consist of merchandise, cord wood, brick, and farm products.

It is believed that if the channel were 6 feet deep at low tide and 75 feet wide the statistics of water commerce for the first 9 months of next year would show an increase of 75 per cent. over the amount of water commerce above reported for the same part of the present year.

The present population of Riverhead is 5,000, in town, but the improvement would benefit the towns of Southold and Southampton.

The Peconic River is the natural water outlet for a surrounding country of about 10 square miles, making the total population which would be interested in the improvement 5,000.

ELIJAH GRISWOLD,
DAVID F. VAIL,
R. T. SKIDMORE,
Capt. J. HARVEY TERRY,
Capt. C. H. PALMER,
Committee.

SURVEY OF PECONIC RIVER, SUFFOLK COUNTY, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, August 18, 1891.

GENERAL: I have the honor to submit the following report on survey of Peconic River, Suffolk County, N Y., directed by your letter of December 10, 1890, in pursuance of the river and harbor act approved September 19, 1890.

My report on preliminary examination, dated December 9, 1890, contains information concerning the commercial importance of this locality with such statistics as I have been able to obtain. An approximate estimate of $60,000 was submitted for a channel from Peconic Bay to Riverhead, a distance of $2\frac{3}{4}$ miles, to be 75 feet wide and 6 feet deep at mean low water, and a turning basin for steamers at the head of the channel. The object of the survey was to make a more accurate estimate and to locate the basin. The survey made in July, 1891, by Mr. Henry N. Babcock, assistant engineer, shows the following:

CONDITION OF CHANNEL.

Merritt Bay is a wide part of the river about 2,000 feet below the head of possible navigation at the highway bridge. Above Merritt Bay the width of the river decreases in the first 700 feet to about 100 feet; farther up it is from 70 to 100 feet wide, and if vessels were to lie at docks on both sides of the river the channel would be impassable. Terry & Wells' Dock (so called) in 1873 was the upper limit of the pro-

ject for improvement; it is about 1,000 feet above Merritt Bay. It appears that the channel above Merritt Bay being too narrow for general use and too narrow for boats of any size to turn in might very well be left to the care of those who own shore property there, making Merritt Bay the head of general navigation and making a basin there large enough for boats to conveniently turn in.

Above Merritt Bay there is a narrow channel from 1½ to 4 feet deep at mean low water.

From the head of Merritt Bay to the mouth of Mud Creek, about 3,500 feet, there is a depth from 4 to 6 feet in a channel now from 40 to 60 feet wide.

From the mouth of Mud Creek to about 1,200 feet below Colonel Island (a distance of 3,500 feet) the channel is 50 to 60 feet wide with middle depths of from 5½ to 7 feet.

Thence to Peconic Bay, a distance of about 5,800 feet, the channel has full 6 feet depth with width from 50 to 80 feet. At about 800 feet below Colonel Island there is a small deposit of hard gravel in the channel for a distance of 400 feet; the rest of the material is mud and rather soft sand. The mean rise and fall of tides is 2.9 feet.

ESTIMATE OF COST OF DESIRED IMPROVEMENT.

To make a channel 75 feet wide and 6 feet deep at mean low water from the head of Merritt Bay to Peconic Bay would require widening the channel 20 feet for practically the whole distance; for 2,000 feet at the upper end it would require deepening for its whole width, and below that for part of the width; the amount to be removed would be about 75,000 cubic yards.

To make a turning basin in Merritt Bay on the north shore of the channel, to be 250 feet wide (including the 75 feet width of channel), 400 feet long, and 6 feet deep, would require excavation of 17,000 cubic yards of sand and mud.

To extend the channel 2,000 feet above Merritt Bay, making it 75 feet wide for 1,000 feet, thence 50 feet wide, would require dredging 37,000 cubic yards.

The cost of the above work, material to be deposited in deep water, in Peconic Bay, about 6 miles from Riverhead, is estimated as follows:

For channel 75 feet wide and 6 feet deep up to the head of Merritt Bay, 75,000 cubic yards, at 30 cents	$22,500
For turning basin in Merritt Bay, 250 feet by 400 feet and 6 feet deep, 17,000 cubic yards, at 30 cents	5,100
Contingencies and supervision	3,400
	31,000
To extend the channel 2,000 feet above Merritt Bay, with widths of 75 and 50 feet, 37,000 cubic yards, at 30 cents	11,100
Contingencies, etc	1,900
Total	44,000

A complete survey of this river was made in 1873 and forwarded to the Chief of Engineers with the Annual Report for 1874. See Annual Report of the Chief of Engineers for 1874, Part II, page 272. The inclosed tracing* shows the localities mentioned above.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

* Not printed.

D 37.

PRELIMINARY EXAMINATION OF SAG HARBOR, SUFFOLK COUNTY, NEW YORK, FOR BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
New York, December 29, 1890.

GENERAL: I have the honor to submit the following report on preliminary examination of Sag Harbor, Suffolk County, N. Y., made in pursuance of the river and harbor act approved September 19, 1890.

It is understood that an examination or survey of this harbor was directed in consequence of a petition to Congress, of which the following is a copy, without signatures:

To the honorable, the Senate and House of Representatives of the United States in Congress assembled.

SAG HARBOR, N. Y., 1889.

The undersigned petitioners, citizens of the port of Sag Harbor, in the county of Suffolk, State of New York, and its vicinity, including those having business interests commercially or otherwise thereat, respectfully represent that the exposed condition of the harbor of this port renders the question of its protection one of very great interest to your petitioners. The entrance to said harbor from Gardiner Bay, being from a northeasterly direction, exposes vessels and wharf property to the hazard of loss and damage during the frequent northeasterly storms and gales experienced from that quarter at certain seasons of the year. So great is this hazard to vessels, steamers, etc., that it is generally deemed unsafe to allow them to lie on the easterly side of the wharves, or ride at anchor there, on the approach of an easterly storm, owing to the force of the waves which naturally sweep in from that direction; while the damage to wharf property itself, consequent upon storms and gales from that direction is oftentimes very great, rendering it expensive to the owners thereof, and resulting finally in a consequent loss or tax upon the maritime interests of the place.

The undersigned beg leave to suggest that a breakwater, properly placed within said harbor, would very materially prevent the disaster and damage now so frequent; and that, owing to the natural formation of the harbor, its general water depths, together with the course of its main channel, a structure of this kind is rendered not only entirely feasible, but that it could be constructed at a comparatively moderate expense.

Your petitioners therefore, hereby respectfully, but earnestly invoke the early and favorable action of your honorable body in behalf of the object herein sought.

The village of Sag Harbor has a population of about 2,700; it is located about 24 miles west of Montauk Point, and is the terminus of the Montauk Division of the Long Island Railroad. The U. S. Coast Pilot states that:

The harbor is south of Shelter Island and about 3 miles southwest from Cedar Island light-house.

The deepest draft of vessels entering the harbor is 13 feet; the usual draft is 9 to 10 feet; 8 to 12 can be taken alongside the wharf.

Formerly Sag Harbor had large whaling interests, but these have entirely ceased. The present commerce of this port is shown by the following statement furnished by the village trustees of Sag Harbor:

COMMERCIAL STATISTICS FOR THE FIRST 9 MONTHS OF THE CURRENT YEAR—JANUARY 1 TO SEPTEMBER 30, 1890.

The amount of freight received by water was:

	Amount.	Value.
Coal ..... tons..	3,958	$19,792.58
Lumber ..... feet..	470,700	14,170.00
Other building materials ..... tons..	2,370	9,378.00
Miscellaneous ..... do...	12,568	1,607,592.00
Total	.....	1,650,932.58

The amount of freight shipped by water was:

	Amount.	Value.
Horses and carriages.....tons..	1,128	$902,750.00
Fish and vegetables.....do...	4,780	123,750.00
General freight.....do...	5,863	1,239,169.00
Total.....	.....	2,265,669.00

The number of vessels which entered the harbor during the above 9 months was (counting each trip of boats entering often), steamers, 306; sail vessels, 75. Tonnage of above boats, 4 to 648 tons; draft, 3 to 12½ feet.

The number of vessels which make regular or frequent trips to and from Sag Harbor is 80.

The population of the village of Sag Harbor is about 2,700.

The harbor is used as a water outlet by a surrounding country of about 217 square miles, including a total population of 8,193.

Number of passengers carried on steamers to or from Sag Harbor during above 9 months, 25,080.

I made a personal examination of this harbor on October 15, 1890, and subsequently had soundings taken for the purpose of ascertaining, approximately, the cost of such improvement as is desired. The water front, where the wharves are located, is exposed to storms from the northeast. A riprap breakwater extending northerly from Conklin Point (about 1,500 feet east of the steamboat wharf) about 3,000 feet, following the line of a shoal on which the depth varies from 2 to 7 feet at mean low water, would afford all the protection needed, and the cost would not exceed $66,000. Great benefit could, however, be given by a smaller expenditure.

In order to properly locate the breakwater and make an estimate of cost a survey is necessary, the cost of which is estimated at $150.

It is apparent that the security of navigation demands protection, which can be given at comparatively small expense, and I am of the opinion that, in view of the present and prospective demands of commerce, the harbor is worthy of improvement.

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

SURVEY OF SAG HARBOR, SUFFOLK COUNTY, NEW YORK, FOR BREAKWATER.

ENGINEER OFFICE, U. S. ARMY,
New York, September 15, 1891.

GENERAL: I have the honor to submit the following report on survey of Sag Harbor, Suffolk County, N. Y., directed by your letter of December 30, 1890, in pursuance of the river and harbor act approved September 19, 1890.

My report on preliminary examination, dated December 29, 1890, contains information as to the commercial importance of this harbor and such commercial statistics as I have been able to procure. An approximate estimate was submitted for a breakwater to protect the water front, where the wharves are located, from northeast storms. The object of the survey was to properly locate the breakwater and to make an

estimate of cost. The accompanying tracing* shows the proposed location and the water front, with soundings. A breakwater so located would effectually protect the water front, and would also shelter an anchorage area of 16 acres having 9 feet depth at mean low water, and about double that area with 6 feet depth.

The estimate of cost is as follows:

For a riprap breakwater, extending from Conklin Point in a north-by-west direction about 1,330 feet, thence in a nearly northwest direction 1,850 feet to the 9-foot curve, being a total length of 3,180 feet; the breakwater to be built to a height of 8 feet above mean low water (about 5 feet above high water), with top width of 5 feet and side slopes of 1 upon 1.	
41,400 tons of riprap, at an average cost of $1.50 per ton	$62,100
Contingencies and supervision, about 15 per cent	8,900
Total estimated cost	71,000

Very respectfully, your obedient servant,

D. C. HOUSTON,
Colonel, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

* Not printed.

APPENDIX E.

IMPROVEMENT OF HUDSON RIVER; OF HARBORS AT SAUGERTIES AND RONDOUT, AND WAPPINGER CREEK; OF NEW YORK HARBOR AND RIVERS AND HARBORS IN ITS VICINITY, NEW YORK; AND OF RARITAN BAY, NEW JERSEY.

REPORT OF LIEUTENANT-COLONEL G. L. GILLESPIE, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1891, WITH OTHER DOCUMENTS RELATING TO THE WORKS.

IMPROVEMENTS.

1. Hudson River, New York.
2. Harbor at Saugerties, New York.
3. Harbor at Rondout, New York.
4. Wappinger Creek, New York.
5. Harlem River, New York.
6. Removing obstructions in East River and Hell Gate, New York.
7. Newtown Creek, New York.
8. Buttermilk Channel, New York Harbor.
9. Gowanus Bay, New York.
10. New York Harbor, New York.
11. Raritan Bay, New Jersey.
12. Removing sunken vessels or craft obstructing or endangering navigation.

EXAMINATIONS AND SURVEYS.

13. Buttermilk Channel and Gowanus Bay Channels in New York Harbor, New York, with a view of straightening the same by removing the shoals opposite the southeast side of Governors Island, protecting the channels by a sea wall on Governors Island, and to provide for the full width thereof a uniform depth of 26 feet at mean low water throughout these channels along the wharves of Brooklyn from a point opposite Wall Street Ferry to the foot of Bryant street, Brooklyn.
14. Bay Ridge Channel, New York, with a view of removing the shoal and providing a uniform depth of 23 feet at mean low water opposite the Bay Ridge shore to the 23-foot curve in the New York Harbor.
15. Champlin Creek, in town of Islip, New York.
16. Hudson River at Cornwall from the Moodna River, otherwise known as Murderer Creek, to the channel or deep water of the Hudson River, New York.
17. Bronx River, New York.
18. Westchester Creek, Westchester and New York Counties, New York.

HARBOR LINES.

19. Establishment of harbor lines in New York Harbor and its adjacent waters.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., July 9, 1891.

GENERAL: I have the honor to transmit herewith annual reports, for the fiscal year ending June 30, 1891, upon the works of river and harbor improvements under my charge.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

E 1.

IMPROVEMENT OF HUDSON RIVER, NEW YORK.

The Annual Report for 1885 contained a history of this improvement, accompanied by original reports and two sketches showing its condition at that time. This may be found in the Annual Report of the Chief of Engineers for 1885, Part I, page 677.

The only part of the Hudson River which has been improved by the General Government is the stretch, about 20 miles long, beginning at the head of navigation at Troy, N. Y., about 6 miles above Albany, and extending down the river to New Baltimore, about 14 miles below Albany.

While there has always been enough water below New Baltimore for navigation, this upper section of the river, so far as its history is known to us, has always been obstructed by bars and shoals, due to the existence of numerous islands and sloughs and the consequent diversion of the river's waters through too many channels.

Prior to 1831, when the jurisdiction of the Federal Government over these waters was confirmed by judicial decision, the State of New York had made efforts to improve the navigation of this part of the river.

Since 1831 the improvement of the Hudson River has been conducted both by the State of New York and the General Government, both building and repairing dikes and doing such dredging as seemed necessary. In the last few years, however, the dike work has been left almost exclusively to the General Government, while the State of New York has done most of the dredging required.

The general system of improvement has been the same throughout, the contraction of the channels by the construction of jetties and dikes intended to deepen them by means of the scour so produced, and also deepening by dredging where it could not be dispensed with.

But up to 1831 the work, which had consisted almost entirely of the construction of spur dikes and dredging, had produced very little permanent improvement.

After 1831, however, the United States began the present general system of improvement, which consists of contracting the channel by means of longitudinal dikes intended to aid in scouring the bars and shoals, instead of using spur jetties, as had been done previously.

Under this system the United States constructed two dikes in 1835, 1836, 1837, and 1838.

Then followed a long interval of time in which nothing was done by the United States, except in 1852; but in 1863 the State of New York took up the improvement on the general plan adopted by the United States in 1831, viz, substituting a system of longitudinal dikes instead of the jetty system, and between 1863 and 1867 built six important longitudinal dikes of this kind. (Annual Report of 1885, page 678.)

The work was again taken up by the United States in 1864, when, out of the general sum appropriated for river and harbor improvements, $33,000 was allotted for the Hudson River improvement, and this was followed by the act of June 23, 1866, which appropriated $50,000 for the same work.

The plans under which the present works of improvement of the river are conducted were adopted in 1866, and provide for securing a navigable channel 11 feet deep at mean low water from New Baltimore up to Albany, and 9 feet deep at mean low water from Albany up to Troy.

The range of tides, determined in 1876, is 2 feet at Troy, 2.32 feet at Albany, and 3.43 feet at New Baltimore.

The following is a description of the plan:

First. A system of longitudinal dikes to confine the current sufficiently to allow the ebb and flow of the tidal current to keep the channel clear. These dikes to be gradually brought nearer together from New Baltimore towards Troy, so as to assist the entrance of the flood current and increase its height, their height to be kept approximately at the level of the tidal high water, so as not to confine the freshets; the exact level, however, being left to be determined by experience as the work progresses.

Second. That the dredge be used so far as necessary to open the channels above described, which the current should not be allowed to do, except very gradually, lest accumulations dangerous to navigation be formed below.

Third. Keeping, as far as practicable, the side reservoirs open to the passage of tidal currents by gaps at their lower extremities, in order to increase the tidal flow.

Fourth. Dumping all dredged material in secure places, where it can not be moved back again into the channel by the current.

Fifth. Constructing the dikes of timber and stone, in a manner to secure their permanency, at a minimum cost, the details varying with the locality, to be left to the discretion of the local engineer, to be so designed as to admit of having an increased height given to the dikes if necessary.

Sixth. To protect, when necessary, the banks and islands against the abrading action of the current by revetments.

Seventh. That limits, beyond which no encroachments upon the channel should be made, be prescribed, and that any such encroachments be reported to the engineer in charge.

The latest revised estimate of cost of this improvement is $1,424,435.

From the nature of the materials which enter into the construction of the dikes and from the limited sums which can be applied annually to renew the parts which become unserviceable, whether by natural decay or otherwise, it can be well understood that the estimates prepared from time to time for the completion of the project can be accepted as approximately accurate for only a short period of time. This statement is necessary for a correct understanding of the apparent discrepancy between the estimated cost of the project and the sums which have been appropriated for its execution.

The State of New York makes an appropriation at every session of its legislature for the improvement of the Hudson River, and prior to 1867 the money was applied to the construction of dikes on the left bank of the river from Hotaling Island to Albany, to jetties, dams, and to temporary measures of relief, and also to dredging at the points where shoals were discovered after spring freshets. In the last few years, however, the dike work has been left almost exclusively to the General Government, while the State has done most of the dredging.

In the future a certain part of each appropriation by the Government for the improvement of the river will probably be applied towards dredging as a means of giving immediate relief to navigation in the early spring by the removal of shoal bars caused by ice jams or freshets.

Sections 6 and 7 of the river and harbor act of September 19, 1890, make it unlawful to dump into the navigable waters of the United States any materials which shall tend to impede or obstruct navigation, or to

excavate or fill or in any manner to alter or modify the course, location, condition, or capacity of the channel of said navigable waters, unless approved and authorized by the Secretary of War. These are wise provisions for giving protection to navigable waters, and will hereafter, in case of the upper Hudson River, remove all occasion for the strained relations which have occasionally arisen in the past between the officer in local charge of the improvement and private contractors in regard to injudicious deposits of material into the navigable channel near Albany. All disturbances of the river bed by dredges, whether made to deepen channels or to procure salable articles of commerce, are now prohibited by law unless specifically authorized by the Secretary of War, and it is hoped that a considerate enforcement of the law will serve hereafter to protect the channel of the river by maintaining its regimen and at the same time to allow material to be taken freely from the river for private and public uses.

The river and harbor act of September 19, 1890, authorized and directed the Secretary of War to appoint a board of three officers of the Corps of Engineers—

> Whose duty it will be to thoroughly examine the obstructions to navigation in the Hudson River between New York City and the State Dam at Troy, N. Y., and report a project and estimate of the cost of widening and deepening said river between New York City and the city of Albany, and also between New York City and the State Dam at the city of Troy, for the navigation of sea-going vessels drawing 20 feet of water, and also a separate estimate of the expense of improving the river between Coxsackie and the State Dam at Troy, to such an extent as to secure a navigable channel 12 feet deep at mean low water. Said board shall accompany their report with a statement as to the usefulness of such improvements and of their relations and value to commerce, and of the advisability of entering upon the same at this time.

The Board was constituted by Special Orders No. 66, Headquarters Corps of Engineers, September 30, 1890, but at the close of the fiscal year the report required by the act has not been submitted.

The average rainfall covering the past 63 years, from observations recorded in the report of the water commissioner of Troy, N. Y., for 1889 is 36.55 inches. The greatest rainfall in any year was recorded in 1878, when 49.23 inches fell; the least rainfall in any year occurred in 1839, when 18.32 inches fell. The greatest known rainfall in any one month occurred in October, 1869, when 13.8 inches fell; the least known rainfall in any one month was in May, 1840, when only 0.2 of an inch fell.

At times during the dry season of most every year, for a month at least, no water flows over the State Dam at Troy, and excepting what comes in through the lockage of the canals there is, during that period, little apparent fresh-water supply to the flow of the river. From this and the fact that the tide rises and falls at the State Dam, it is evident that the navigation of the Hudson River at the low stage is dependent upon the tidal prism of the river.

The mean rise and fall of tides—

	Feet.
At State Dam, Troy, N. Y., is	0.80
At Nail Works, Troy, N. Y., is	1.92
At Albany, N. Y., is	2.32
At Castleton, N. Y., is	2.53
At New Baltimore, N. Y., is	3.42
At New York, Governor Island, from Coast Survey	4.40

The mean duration of rise of tide at Albany is 5 hours, 0 minutes, and the mean duration of fall, 7 hours, 25 minutes.

The elevation of mean low water at New York below that—

	Feet.
At New Baltimore is	3.55
At Castleton is	4.35
At Albany is	4.78
At Troy Nail Works is	5.32
At Troy State Dam is	6.88

The elevation of mean high water at New York below that—

	Feet.
At New Baltimore is	2.57
At Castleton is	2.48
At Albany is	2.70
At Troy Nail Works is	2.84
At State Dam, Troy, is	3.28

The heights of the greatest known freshets above the plane of mean low water at Albany are as follows:

That of February 9, 1857, due to an ice gorge at Van Wies Point, was 22.19 feet.

That of October, 1869, due to the great rainfall in that month which reached 13.8 inches, was 19.04 feet.

That of February, 1886, due to an ice gorge, was 17.89 feet.

Generally speaking, the effects of rain storms are shown by a rise in the river within 24 hours. The winds also materially affect the height of the water; south and east winds drive the water up the river causing very high tides, while a north or west wind produces an opposite effect.

BRIDGES ACROSS THE HUDSON RIVER.

The following table gives the location and essential features of all the bridges which cross the line of navigation of the river:

Name and location of bridge.	Draw span.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Ft. In.	*Ft. In.*	*Ft. In.*	
New York Central and Hudson River Railroad Bridge at Bridge avenue, Troy, N. Y.	198 6	61 6	23 10	Single draw; railroad, wagon, and passenger bridge; iron on stone piers; draw pier on land, east shore; at right angles to stream; 6 piers in river; draw opened by steam power.
Congress Street Bridge, Troy, N. Y.	258 0	104 0	29 6	Double draw; wagon and passenger bridge; iron, on stone piers, slightly oblique to direction of stream; 2 piers and draw pier in river; draw opened by hand power.
New York Central and Hudson River Railroad Upper Bridge, Albany, N. Y.	275 0	110 7	33 5	Double draw; railroad freight bridge; iron, on stone piers, at right angles to stream; 4 piers and draw pier in river between bulkhead lines; draw opened by steam power.
New York Central and Hudson River passenger railroad bridge, Albany, N. Y.	275 0	115 4	28 1	Double draw; railroad and passenger bridge; iron, on stone piers, at right angles to stream; 4 piers and draw pier in river; draw opened by steam power.
Lower bridge, Greenbush bridge, Albany, N. Y.	400 0	169 8	22 7	Double draw; wagon and passenger bridge; iron, on stone piers, at right angles to stream; 2 piers and draw pier in river; draw opened by steam power.
The Poughkeepsie Bridge, Poughkeepsie, N. Y.	.....	.....	160 0	No draw; railroad bridge; iron, on iron piers with stone foundations at right angles to stream; 4 piers in river; 5 spans—548 feet, 525 feet, 546 feet, 525 feet, and 548 feet; cantilever bridge.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

At the beginning of the fiscal year, July 1, 1890, the following contracts were still in force: Contract with John Kelly, dated August 31, 1889, expiring December 31, 1890, for repairing certain dikes enumerated in last report in the Hudson River between Troy and New Baltimore; and contract with William Fuller & Sons, dated March 14, 1890, and expiring October 31, 1890, for constructing 2,100 feet of dike along the east shore of the Hudson River at Mull Plaat.

Work under both contracts was continued until their expiration, when the contracts were closed.

The contract with John Kelly included the repairs to Small Island, Bath, and Base Island Dikes, but owing to the difficulty in getting stone for these repairs and the necessity for doing immediate additional work to the Port Schuyler Dike to protect it, the plan of work was so modified as to abandon the repairs to the above-mentioned dikes and to complete in full the repairs to the Port Schuyler Dike. On account of the extremely cold weather, however, the contractor was forced to discontinue work on December 17, 1890. The repairs were not quite completed, but as little work remained to be done and navigation was closed, making further work impossible, the contract was closed at its expiration.

On September 24, 1890, a project was submitted for the application of the appropriation contained in the act of September 19, 1890, for continuing the improvement of the Hudson River.

The project, which was approved September 27, 1890, included the following:

Permanent works to complete the project.

Extension of Mull Dike to Shad Island, 2,200 feet			$33,000
Extension of Mull Plaat Dike, 800 feet			3,400
Construction of 1,800 feet of half dike below Nine-Mile Tree			6,000
Removal of Overslough Rock	cubic yards	900	
Removal of Dettingers Rock	do	300	
		1,200	21,600
Total			64,000

Rebuilding and repairing existing dikes.

Base Island dike	$5,000
Patroon Lower Island Crib Dike	5,000
Bath Dike	1,500
Small Island Dike	2,000
Overslaugh Dike, No. 1	3,000
Overslaugh Dike, No. 2	5,000
Campbell Island Dike	2,000
Cow Island Dike	1,000
Castleton Dike	500
Mull Island Dike	5,000
West Dike	5,000
Total	35,000
For surveys and expenses of Board of Engineers to report on new project under act of September 19, 1890	$10,000

Dredging between Albany and Troy.

Washington Bar	cubic yards	10,000	
Fish House Shoal	do	10,000	
Total		20,000	$5,000

Dredging between Albany and New Baltimore.

Bogart Light Shoal	cubic yards	10,000	
Winnie Bar	do	10,000	
Mull Cross-Over	do	60,000	
Total		80,000	$20,000

Sealed proposals for removing Dettinger and Overslaugh Rocks were invited by public advertisement October 4, 1890, and for construction of new dikes, repairs to old dikes, and dredging, October 15, 1890.

E. R. Lowe was the only bidder for the removal of the rock. The contract was awarded him, but as he failed to complete his bond after signing the contract the award was canceled and the work was authorized to be done by hired labor, using the Government drilling plant formerly employed on the Raritan River improvement.

Work began with this plant May 9, 1891, for the removal of Dettinger Rock, and is now in progress.

William Fuller & Sons being the lowest bidders on the work of constructing new dikes and repairing existing dikes, contract was entered into with them January 13, 1891, and work is now in progress.

The bids for dredging having been unsatisfactory, proposals were readvertised for December 22, 1890, and contracts entered into with P. W. Myers for the removal of 60,000 cubic yards of material at Mull Cross-Over, at the price of $14\frac{3}{4}$ cents per yard, and with E. M. Payn, for the removal of 10,000 cubic yards at Winnie Bar, at $17\frac{8}{9}$ cents per cubic yard; 10,000 cubic yards at Bogart Light Shoal, at $11\frac{8}{9}$ cents per cubic yard; 10,000 cubic yards at Fish House Shoal, at 19 cents per cubic yard, and 10,000 cubic yards at Washington Bar, at $21\frac{9}{10}$ cents per cubic yard.

Work under these contracts has been in progress since the opening of navigation.

When the spring freshet had subsided and the water had reached nearly the low-water mark, it was discovered that the ice jams which had formed during the winter in the river above Albany had extended the Fish House Shoal down stream so as to make it continuous with the Kellogg Shoal, and had raised the bottom to such a degree that the navigable depth over these two shoals was reduced to about 6 feet, mean low water.

This shoaling proved very obstructive to navigation, and in the interest of commerce authority was asked and received to make an open-market agreement with the contractor for Fish House Shoal, on the completion of his contract, for the removal, at the contract price, of 15,000 cubic yards of material in addition to the contract quantity. This work was completed in June, the details of which are given further on.

In addition to the above, the following open-market agreements were made:

With William Fuller & Sons, for driving guide piles to delineate submerged dikes near the channel.

With P. W. Myers, for removing wrecks near Pleasure Island, at Papscannee Dike, and near Mull Plaat Dike.

Also with P. W. Myers, dated April 14, 1891, for removing wrecks at Willow Island Light and opposite Matthews Point, below New Baltimore.

The progress made under the above contracts and open-market agreements during the fiscal year may be summarized as follows:

REPAIRS TO DIKES AND CONSTRUCTION OF NEW DIKES.

Barren Island Dike.—Three hundred feet of the upper end of this dike were refilled with stone where settlement had taken place. Material used, 158 cubic yards large stone.

Five hundred feet of the lower end of this dike were badly undermined, and the dike overturned. The project for repairs in 1880 was to remove 400 feet of this lower end, and in accordance therewith some of the stone was removed in that year.

The contract with John Kelly, August 31, 1889, called for repair of this dike by the construction of a stone embankment over the old structure. On account of the near proximity of the channel to this dike, and the danger to vessels alleged by shipmasters, of this mode of repair, the plan was modified and a timber structure consisting of a row of piles, driven front and rear, every 5 feet, connected by a single course of waling timber and tied together by iron tie rods, was built over the old work. This has kept the old dike from falling over, but was only intended as temporary, and so arranged that it would be part of the reconstruction of this lower end.

Roah Hook Dike.—A portion of this dike was refilled with stone where settlement had taken place. Material used, 228 cubic yards stone.

Mull Dike.—This dike was in course of construction at the beginning of the fiscal year, and was completed August 30, 1890. It is 1,790 feet long, and consists of an embankment of small rubblestone, topped off with large stone placed with some regard to bond. The material furnished and put in this work during the year consisted of 1,685 cubic yards small stone, and 4,517 cubic yards large stone. The cost per running foot of this dike was $12.46.

Mull Plaat Dike.—This dike, which consists of an embankment of small stone, topped off with large stone placed with some regard to bond and held in place by a skewback of timbers, was built to protect the shore from erosion, as well as to assist in directing the flow of the current. It is 2,135 feet long, and was completed November 1, 1890, at a cost of $4.47 per running foot.

Shad Island Dike.—Additional stone filling was placed in this dike where settlement had taken place. Material used, 112 cubic yards stone.

Cedar Hill Dike.—The repairs to this dike, which were in progress at the beginning of the fiscal year, were completed November 30, 1890. The timber work was renewed for a distance of 325 feet at the upper end, and that portion filled with stone for a distance of 3,475 feet, and an embankment of stone was built over the old dike. These stone were properly placed and the embankment rounded off by hired labor.

The timber work for 1,000 feet of the lower end of this dike is in very bad condition, and it is recommended that an embankment of stone be built over the old work. Estimated cost, $2,500.

Winnie Dike.—The timber work for 500 feet of the lower end of this dike was rebuilt, and the dike filled with stone.

Stone Light Dike.—Eight hundred and fifty feet of the lower end of this dike were revetted with large stone, carefully placed, and completed August 30, 1890. Material used, 1,371 cubic yards large stone.

Douw Point Dike, Douw Point Dike Extension South; Papscannee Dikes, Sections I, II, and III, with Cross Dams.—In all, a total length of 13,950 linear feet was repaired. A stone embankment was built over 3,600 feet of this length, and the balance, 10,350 feet, was filled with stone. The whole structure was rounded off, and stone properly placed

by hired labor. Material used, 1,983 cubic yards small stone, and 5,119 cubic yards large stone.

Abbey Channel Dike.—This dike for a length of 500 feet was refilled with stone. Material used, 227 cubic yards large stone.

Bogart Island Dike.—The original plan for repairs to this dike included the closing of several breaks aggregating 400 feet in length. This was modified somewhat, as it was deemed expedient to keep the lower break open to afford a route to the dump ground in the rear, and upon application of E. M. Payn authority was granted to him to keep open the break just north of Bogart Light. The other breaks were only partly repaired, owing to the difficulty in getting stone. Material used, 220 cubic yards.

An additional 300 cubic yards of stone will be required to complete these repairs, which, with other material, may be supplied at the estimated cost of $1,500.

High Dike.—The lower break in this dike, 500 feet long, was fully completed. An embankment of dredged material was thrown up, and a stone revetment built over it. The upper break was only partly repaired, and requires an additional 500 cubic yards of stone; estimated cost, $700. Material used, 1,155 cubic yards large stone, and 1,499 cubic yards dredged material.

Port Schuyler Dike.—Several breaks in this dike, aggregating 600 feet, were repaired. An embankment of dredged material was thrown up, and a stone revetment paved over it. A gap was left in the upper break 50 feet wide, to allow for circulation of water behind the dike and afford a way to haul dredged material to the dump ground in the rear. This opening was protected on either side by a timber bulkhead.

DREDGING.

Under the several contracts and open-market agreements the following dredging has been done:

For a distance of 1,200 feet at *Mull Cross-Over*, opposite Mull Light, the channel has been widened 150 feet and dredged to a uniform depth of 11 feet at mean low water. The present width of channel at this point is 500 feet. The dredging at Mull is intended to straighten the channel, which at present is somewhat in the form of a letter S, and a difficult part of the river to navigate. To date 33,000 cubic yards of material have been removed, and much benefit derived. The work is still in progress.

At *Winnie Bar* 10,000 cubic yards of material have been removed, giving a good channel 250 feet wide and 11 feet deep at mean low water.

At *Bogart Light Shoal* 10,000 cubic yards of material have been removed, and the channel widened so that there is now a channel 250 feet wide with a uniform depth of 11 feet.

At *Fish House Shoal* 10,000 cubic yards of material have been removed, giving a channel 150 feet wide with a uniform depth of 9 feet.

The bar extending to *Kellogg Shoal* has been almost entirely removed, and a channel 130 feet wide and 9 feet deep dredged through it. Material dredged and removed, 12,000 cubic yards.

All of the above shoals exist where there is quite a deflection of the current and the channel is continually being narrowed up by deposits. More or less dredging will be required each year.

The difficulty of disposing of the material dredged is becoming more serious every year, and especially with the plant now in use, as there is not sufficient water behind the dikes to allow a scow to be floated and

dumped. In consequence, the contractors have been obliged to dredge out an access to the dump ground, which requires double handling and considerable expense. This will materially affect the price of future dredging on the river.

WRECKS.

Wrecks of canal barges have been removed from the river at the following points:

Opposite Pleasure Island Dock;
Opposite Bogart Light;
Opposite North Coeymans Dock;
Near Willow Island Light; and
Below New Baltimore, opposite Matthew Point.

These wrecks were broken and torn up with a dredge, and the material placed where it could not be washed or floated into the river.

ROCKS.

During the season of 1890, one of the Albany boats drawing 9 feet of water struck something in mid-channel just below Van Wie Point and opposite Dettinger Dock that was supposed to be a wreck, but on examination was found to be a rock, with a least depth of 8.7 feet of water over it, and covering an area above the 12-foot plane of 175 by 60 feet.

Work by hired labor, and the use of a drill scow, to remove this rock to a depth of 12 feet at mean low water has been in progress since May 9, and to date over one-half the area had been blasted. It is expected that the removal of this rock will be completed by August 1, when work will be started to remove the Overslaugh Rock.

To prepare for operations on Overslaugh Rock, an open-market agreement has been made under authority with E. M. Payn & Co. to do the necessary dredging for temporary channel and trench around the rock, for $11\frac{8}{9}$ cents per cubic yard.

At the opening of navigation, guide piles were driven along such submerged dikes as are adjacent to the channel, to mark their alignment and prevent vessels from running into them. This is necessary each year.

Work repaving by hired labor portions of the dike at Pleasure Island has been done this spring, and work repaving the Overslaugh Dike is now in progress. Paving relaid, 2,000 square yards.

It is claimed by boatmen that the channel between Troy and New Baltimore is in better condition than ever before. Further dredging to give additional width at the several bars would be of great benefit, as also the removal of the Willow Island shoal at New Baltimore. This shoal moves down the river every year, and is filling up the space in front of the dikes at New Baltimore.

There are two places along the river where there is continual erosion going on, and where the construction of a dike or revetment would be of great advantage—along the shore of Breaker Island near Troy for 2,000 feet, and at Roah Hook, near Coeymans, for a distance of 1,300 feet, running north. The protection of these shores is recommended.

The Troy Steel and Iron Company are constructing a bulkhead along the shore at their dump, to comply with the requirements of the law. In general, there is an inclination on the part of all concerned to comply with the requirements of the act of September 19, 1890.

Under authority of the Chief of Engineers, dated March 22, 1890, a

retriangulation of the river from Troy to Coxsackie and a reëstablishment of the bench marks was begun in April, 1890. This was continued, and the field work entirely completed, connecting the Government system with the State monuments from Troy to Coxsackie, which has since been extended to the city of Hudson. This latter was part of the work necessary to secure the data for an estimate of cost of widening and deepening the river for the navigation of vessels drawing 20 feet of water, to comply with the act of September 19, 1890.

Surveys and examinations were also made at the following points: State Dam, Washington Bar, Fish House Shoal, Kellogg Shoal, Bogart Light Shoal, along Overslaugh Dike, Austin Rock, Dettinger Rock, Winnie Bar, Mills Cross-Over, and Willow Island Shoal.

Also, under authority, in compliance with the act of September 19, 1890, borings have been made along the channel of the river from the State Dam at Troy to the city of Hudson, and examinations have been made of the shoals at Stuyvesant, Coxsackie, Four Mile Point, Priming Hook, and Athens to determine the depth to rock and the material of deposit, in order to make an estimate of the cost of deepening the channel for sea-going vessels drawing 20 feet water.

Tidal observations covering 4 months were also taken at four points between Troy and New Baltimore, to determine the relative elevation of the plane of mean low water to that previously established. No difference in the planes was found.

Levels have been run between Albany and Troy, and bench marks reëstablished, completing the levels between Troy and Coxsackie.

The permanent works remaining to be built in order to complete the improvement as originally projected are:

(1) Completion of dike from Staat Island to Campbell Island.
(2) Completion of dike from Schermerhorn Island to Shad Island.
(3) Improvement at Willow Island.

The cost of completion of these works is estimated at $90,000.

The balance available at the close of the fiscal year and not put under contract is $57,639.09. This will be used partly in defraying the running expenses of the steam-drill scow for 1 year, estimated at $20,000; in defraying cost of the survey of the Hudson River and preparation of plan for enlarged project, $5,000; and in making repairs to dike by hired labor at an estimated cost of $5,000. The residue, amounting to $27,000, approximately, will be reserved in the interest of navigation for contingencies of dredging in the spring of 1892, for the removal of bars which may be discovered in the upper part of the river as the result of ice jams and unusual freshets, and also for the removal of wrecks of canal boats and barges which may be wrested from their moorings by the ice when the spring flow begins.

Mr. Charles G. Weir, assistant engineer, has been in personal charge of this improvement during the year, and has conducted his work with efficiency and economy.

This work is in the collection district of New York, Albany being a port of entry.

Amounts appropriated.

By act of Congress approved—	
June 30, 1834	$70,000.00
July 2, 1836	100,000.00
March 3, 1837	100,000.00
July 7, 1838	100,000.00
August 30, 1852	50,000.00
	420,000.00

Amounts appropriated for present project.

By act of Congress approved—	
June 26, 1864, allotment	$33,000.00
June 23, 1866	50,000.00
March 3, 1867	305,188.00
July 25, 1868	85,000.00
April 10, 1869	89,100.00
July 11, 1870	40,000.00
March 3, 1871	40,000.00
June 10, 1872	40,000.00
March 3, 1873	40,000.00
June 23, 1874	40,000.00
March 3, 1875	40,000.00
August 14, 1876	50,000.00
June 18, 1878	70,000.00
March 3, 1879	30,000.00
June 14, 1880	20,000.00
March 3, 1881	15,000.00
By act of Congress passed August 2, 1882	10,000.00
By act of Congress approved—	
July 5, 1884	30,000.00
August 5, 1886	26,250.00
August 11, 1888	75,000.00
September 19, 1890	150,000.00
Total	1,278,538.00
Received from other sources	792.57
	1,279,330.57
Amount expended to June 30, 1891, inclusive of outstanding liabilities	1,162,011.70

Money statement.

July 1, 1890, balance unexpended		$63,491.23
Amount appropriated by act approved September 19, 1890		150,000.00
		213,491.23
June 30, 1891, amount expended during fiscal year		85,148.52
July 1, 1891, balance unexpended		128,342.71
July 1, 1891, outstanding liabilities	$11,023.84	
July 1, 1891, amount covered by uncompleted contracts	59,679.78	
		70,703.62
July 1, 1891, balance available		57,639.09
Amount (estimated) required for completion of existing project		145,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		145,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for improving Hudson River, New York, received in response to advertisement dated October 4, 1890, and opened October 30, 1890, by First Lieut. Harry Taylor, Corps of Engineers, in the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

Quantities.	1. Edward R. Lowe.*	
	Price per cubic yard.	Amount.
Removal of Dettinger Rock (550 cubic yards), excavating and placing rock and sand covering	$9.20	$5,060.00
Removal of Overslaugh Rock (1,600 cubic yards), excavating and placing rock and sand covering	8.95	14,320.00
Dredging to form temporary channel (6,000 cubic yards, dredging and measured in scows)	.18¾	1,125.00
Total amount	.....	20,505.00

* Only bid received.

Tabular statement showing prices of revised proposals of E. R. Lowe, dated December 8, 1890, for improving Hudson River, New York.

Quantities.	Per unit.	Amount.
Removal of Dettinger Rock (600 tons) ....ton..	$8.50	$5,100.00
Removal of Overslaugh Rock (1,500 tons) ....do...	8.29	12,435.00
Dredging temporary channel (6,000 cubic yards) ....cubic yard..	.18¾	1,125.00
Total amount....	.....	18,660,00

Abstract of proposals for improving Hudson River between New Baltimore and Troy, N. Y., received in response to advertisement dated October 15, 1890, and opened November 19, 1890, by First Lieut. Harry Taylor, Corps of Engineers, in the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

CONSTRUCTION OF NEW DIKES.

Material, etc.	1. Peter J. Brummelkamp.		2. James DuBois, Abraham DuBois.		3. William Parrott.		4. J. H. Fenner.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Pine or spruce piles (133,120 linear feet)....1 foot..	.....	.....	$0.14	$18,636.80	$0.11½	$15,308.80	.....	.....
Round timber (2,600 linear feet, in place)....1 foot..	.....	.....	.12	312.00	.08	208.00	.....	.....
Square timber, yellow pine (144,700 B. M. feet, in place)....M feet B. M...	.....	.....	35.00	5,064.50	38.00	5,498.60	.....	.....
Tie rods and screw bolts (41,330 pounds, in place), pound	.....	.....	.06	2,479.80	.04	1,653.20	.....	.....
Drift bolts, spikes, and washers (15,700 pounds, in place)..... pound..	.....	.....	.05	785.00	.04	628.00	.....	.....
Ordinary or small rubblestone (10,900 cubic yards, placed in dikes), cubic yard	.....	.....	1.05	11,445.00	.99	10,791.00	.....	.....
Large rubblestone (2,000 cubic yards, placed in dikes....cubic yard..	.....	.....	*1.05	2,100.00	*.99	1,980.00	.....	.....
Dredging for backing (3,500 cubic yards...cubic yard..	.....	.....	.....	.....	.14	490.00	.....	.....
Total amount.....	.....	.....	.....	40,823.10	.....	36,557.60	.....	.....

Material, etc.	5. George Humphreys.*		6. John Kelly.		7. Edgar M. Payn.		8. Peter W Myers.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Pine or spruce piles (133,120 linear feet)....1 foot..	$0.18	$15,840.00	$0.15	$19,968.00	.....	.....	.....	.....
Round timber (2,600 linear feet, in place)....1 foot..	.....	.....	.10	260.00	.....	.....	.....	.....
Square timber, yellow pine (144,700 B. M. feet, in place), M. feet, B. M	42.00	3,838.80	43.00	6,222.10	.....	.....	.....	.....
Tie rods and screw bolts (41,330 pounds, in place), pound....	.05	1,661,50	.06	2,479.89	.....	.....	.....	.....
Drift bolts, spikes, and washers (15,700 pounds, in place)....pound..	.05	425.00	.05	785.00	.....	.....	.....	.....
Ordinary or small rubblestone (10,900 cubic yards, placed in dikes) ....cubic yard..	.90	8,100.00	*1.15	12,535.00	.....	.....	.....	.....
Large rubblestone (2,000 cubic yards, placed in dikes, cubic yard....	*.90	1,800.00	*1.15	2,300.00	.....	.....	.....	.....
Dredging for backing (3,300 cubic yards)..cubic yard..	.....	.....	.35	1,225.00	.....	.....	.....	.....
Total amount.....	.....	31,665.30	.....	45,774.90	.....	.....	.....	.....

* Bid for extension of Mull Dike only.

Abstract of proposals for improving Hudson River, etc.—Continued.

CONSTRUCTION OF NEW DIKES—Continued.

Material, etc.	9. James B. Donnelly.		10. Francis H. Smith.		11. William Fuller & Sons.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Pine or spruce piles (133,120 linear feet).....1 foot..	$0.19	$25,292.80	$0.15	$19,968.00	$0.11½	$15,308.80
Round timber (2,600 linear feet, in place).....1 foot..	.25	650.00	.15	390.00	.12	312.00
Square timber, yellow pine (144,700 B. M. feet, in place), M feet B. M.....	40.00	5,788.00	57.50	8,320.25	38.00	5,498.60
Tie rods and screw bolts (41,330 pounds, in place).....pound..	.04	1,653.20	.05	2,066.50	.05	2,066.50
Drift bolts, spikes, and washers (15,700 pounds, in place) .pound.	.04	628.00	.05	785.00	.04	628.00
Ordinary or small rubble stone (10,900 cubic yards, placed in dikes), ... cubic yard..	1.50	16,350.00	1.59	17,331.00	.90	9,810.00
Large rubblestone (2,000 cubic yards, placed in dikes), cubic yard.....	1.50	3,000.00	*1.59	3,180.00	*.90	1,800.00
Dredging for backing (3,500 cubic yards).....cubic yard..	.15	525.00	.85	2,975.00	.18	630.00
Total amount.....	.....	53,887.00	.....	55,015.75	.....	†36,053,90

* Omitted in proposals; calculated at rate bid for ordinary rubblestone, and amount added to "total amount."

† Lowest bid.

REBUILDING AND REPAIRING EXISTING DIKES.

Materials, etc.	1. Peter J. Brummelkamp.		2. James Du Bois, Abraham DuBois.		3. William Parrott.		4. J. H. Fenner.		5. George Humphreys.		6. John Kelly.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Pine or spruce piles (30,150 lin. feet), 1 foot.....	.....	.....	$0.14	$4,221.00	.....	.....	.....	.....	.....	.....	.....	.....
Round timber (4,700 lin. feet, in place), 1 foot.....	.....	.....	.12	564.00	.....	.....	.....	.....	.....	.....	.....	.....
Square timber, yellow pine (80,650 ft. B. M., in place), M. feet. B. M.....	.....	.....	35.00	2,822.75	.....	.....	.....	.....	.....	.....	.....	.....
Tie-rods and screw-bolts (27,900 pounds, in place), pound....	.....	.....	.06	1,674.00	.....	.....	.....	.....	.....	.....	.....	.....
Drift-bolts, spikes, and washers (5,100 lbs. in place), pound.	.....	.....	.05	255.00	.....	.....	.....	.....	.....	.....	.....	.....
Large stone (7,300 cub. yds., in place), c. yd.....	.....	.....	1.35	9,855.00	.....	.....	.....	.....	.....	.....	.....	.....
Ordinary rubble stone (3,725 cub. yds., in place), c.yd.	.....	.....	1.30	4,842.50	.....	.....	.....	.....	.....	.....	.....	.....
Small rubble stone (3,250 cu. yds., in place), cu. yard.....	.....	.....	1.30	4,225.00	.....	.....	.....	.....	.....	.....	.....	.....
Paving stone (700 cu. yds., in place), c.yd.	.....	.....	2,30	1,610.00	.....	.....	.....	.....	.....	.....	.....	.....
Dredging for backing (1,100 cubic yards), cubic yard..	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Total amount..	.....	.....	.....	30,069.25	.....	.....	.....	.....	.....	.....	.....	.....

Abstract of proposals for improving Hudson River, etc.—Continued.

REBUILDING AND REPAIRING EXISTING DIKES—Continued.

Materials, etc.	7. Edgar M. Payn.		8. Peter M. Myers.		9. James B. Donnelly.		10. Francis H. Smith.		11. William Fuller & Sons.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Pine or spruce piles (30,150 lin. feet), 1 foot	.....	.....	.....	.....	.....	.....	$0.15	$4,522.50	$0.11	$3,316.50
Round timber (4,700 lin. feet, in place), 1 foot	.....	.....	.....	.....	.....	.....	.15	705.00	.10	470.00
Square timber, yellow pine (80,650 feet B. M., in place) M feet B. M	.....	.....	.....	.....	.....	.....	57.50	4,637.38	40.00	3,226.00
Tie-rods and screw-bolts (27,900 pounds, in place), pound	.....	.....	.....	.....	.....	.....	.05	1,395.00	.05	1,395.00
Drift bolts, spikes, and washers (5,100 lbs., in place), pound	.....	.....	.....	.....	.....	.....	.05	255.00	.04	204.00
Large stone (7,300 cub. yds., in place), cubic yard	.....	.....	.....	.....	.....	.....	1.65	12,045.00	1.35	9,855.00
Ordinary rubble stone (3,725 cub. yds., in place), cubic yard	.....	.....	.....	.....	.....	.....	1.59	5,922.75	.95	3.538.75
Small rubble stone (3,250 cu. yds., in place), cubic yard	.....	.....	.....	.....	.....	.....	1.59	5,167.50	.95	3,087.50
Paving stone (700 cubic yards in place), cubic yard	.....	.....	.....	.....	.....	.....	2.15	1,505.00	1.20	840.00
Dredging for backing (11,000 cubic yards), cubic yard	.....	.....	.....	.....	.....	.....	.85	935.00	.18	198.00
Total amount	.....	.....	.....	.....	.....	.....	.....	37,090.13	.....	*26,130.75

*Lowest bid.

DREDGING.

Quantity.	1. Peter J. Brummelkamp.		2. James and Abraham DuBois.		3. William Parrott.		4. J. H. Fenner.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Dredging 100,000 cubic yards material, measured in scows	$0.30	$30,000	.....	.....	.....	.....	*$0.15	$10,500

Quantity.	5. George Humphreys.		6. John Kelly.		7. Edgar M. Payn.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Dredging 100,000 cubic yards material, measured in scows	.....	.....	$0.32 3/10	$32,200	$0.25	$25,000

Quantity.	8. Peter W. Myers.		9. James B. Donnelly.		10. Francis H. Smith.		11. William Fuller & Sons.	
	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.	Per unit.	Amount.
Dredging 100,000 cubic yards material, measured in scows	$0.24 3/4	$24,750	.....	.....	.....	.....	.....	.....

*Bids for dredging at Washington Bar and Mull Cross-Over aggregating 70,000 cubic yards.

Abstract of proposals for dredging in the Hudson River between New Baltimore and Troy, N. Y., received in response to advertisement dated December 22, 1890, and opened January 22, 1891, by First Lieut. Harry Taylor, Corps of Engineers, in the official absence of Lieut. Col. C. L. Gillespie, Corps of Engineers.

[Dredging 100,000 cubic yards material from the Hudson River.]

No.	Name of bidder.	Washington Bar, 10,000 cubic yards.		Fish House Shoal, 10,000 cubic yards.		Bogart Light Shoal, 10,000 cubic yards.	
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic yard.	Amount.
1	P. J. Brummelkamp	$0.30	$3,000	$0.22	$2,200	$0.24	$2,400.00
2	Peter W. Myers	.30	3,000	.20	2,000	.14	1,400.00
3	J. H. Fenner	.29	2,900	.35	3,500	.30	3,000.00
4	Edgar M. Payn	†.21 9/10	2,190	†.19	1,900	†.11 8/9	1,888.89
5	Richard Parrott					.24 1/2	2,450.00

No.	Name of bidder.	Winnie Bar, 10,000 cubic yards.		Mull Cross-Over, 60,000 cubic yards.	
		Per cubic yard.	Amount.	Per cubic yard.	Amount.
1	P. J. Brummelkamp	$0.24	$2,400.00	$0.24	$14,400
2	Peter W. Myers	.25	2,500.00	*.14 3/4	8,850
3	J. H. Fenner	.30	3,000.00	.18	10,800
4	Edgar M. Payn	†.17 8/9	1,788.89	.18 9/10	11,340
5	Richard Parrott	.24 1/2	2,450.00	.23	13,800

*Lowest bid for Mull Cross-Over.
†Lowest bids for Washington Bar, Fish House Shoal, Bogart Light Shoal, and Winnie Bar.

COMMERCIAL STATISTICS.

The information contained in the report made last year on the commercial statistics of the Hudson River by Mr. Charles G. Weir, assistant engineer, was so complete, that it is deemed best to repeat it in the report for this year.

The importance of the Hudson as a great water way of commerce is apparent when it is known that aside from its own local traffic, which in itself is very large, it absorbs all the traffic of the Erie, Champlain, and Delaware and Hudson Canals, besides the great coal trade of the Pennsylvania Coal Company at Newburg and the Erie coal trade at Piermont. The average season of navigation of the river is 240 days and that of the canals 220 days.

The Erie Canal, extending from Albany to Buffalo, on Lake Erie, a distance of 352 miles, with a difference of level of 577 feet, and to Oswego, on Lake Ontario, connects the Great Northern Lakes with the Hudson River, and brings in immense commerce from the Northwest and Canada. The principal items of this commerce are lumber and grain.

The Champlain Canal, 69 miles long, connects Lake Champlain with the Hudson River. This lake, which is 93 feet above tide of the Hudson, and whose waters flow into the St. Lawrence, is connected by the Chambly Canal with the St. Lawrence River below Montreal. The principal items of tonnage on this canal are lumber and iron ore. The above canals, with 575 miles of subsidiaries, constitute the New York State canals. The Erie Canal enters the Hudson by three tide-water locks, one at the foot of Twenty-third street, West Troy; one at foot of Eighth street, West Troy; and a third at the lumber district, Albany.

The Champlain Canal enters the river at Waterford, 3 miles above the State Dam, and boats are locked through the dam to tide water. It is also connected with the Erie Canal, and, through its tide-water locks, with the Hudson River.

The Delaware and Hudson Canal enters the Hudson through Rondout Creek at Rondout, N. Y., and brings the anthracite coal country at Honesdale and the Delaware River into water communication with the Hudson. The principal items of tonnage on this canal are coal, bluestone, and cement. Aside from the above feeders

to the commerce of the Hudson, the Pennsylvania Coal Company has a large tide-water coal depot at Newburg where also the Erie Railroad has a terminal point and transfers large quantities of freight by boat across the river. The Erie Railroad also has a coal depot at Piermont, 20 miles above New York, where preparations are being made to handle a very large supply.

The following statistics include the tonnage received at all points above Spuyten Duyvil Creek, and of the local shipment between points on the river only that shipped is credited to the points from which it was shipped, no entry being made to the total tonnage of the amount received at local points from other local points. The total tonnage also includes all through freight shipped from points up the river that passed the mouth of Spuyten Duyvil Creek going south.

The two principal industries on the river which add materially to the total tonnage are ice and brick. The capacity of the ice houses on and adjacent to the river exceeds 4,000,000 tons, and amount generally harvested 3,500,000. The brick manufactured on the river exceed 850,000,000.

Total tonnage of all shipping points on the Hudson River during 1889, not including the tonnage coming through State canals	tons..	15,033,309
Value of same		$378,196,094
Total tonnage coming to and leaving tide-water through State canals, 1889	tons..	3,592,437
Value of same		$108,000,000
Increase of same over tonnage, 1888	tons..	326,466
Grand total tonnage of the Hudson River, including the tonnage through State canals	tons..	18,582,596
Value of same		$485,733,094

This does not include the value of vessels carrying the above trade, which are equally exposed to the dangers of navigation.

Total number of vessels registered at Albany, 1889		515
Total tonnage of same	tons..	73,921
Total value of imports at port of Albany, 1889		$852,271.00
Total duties collected on same		156,493.52
Number of transportation companies for passengers or freight, not including individual steamboats or pleasure boats		30
Total number of passengers carried, 1889		5,000,000
Total population along the river		450,000

E 2.

IMPROVEMENT OF SAUGERTIES HARBOR, NEW YORK.

The harbor of Saugerties is the name applied to the mouth of Esopus Creek, which empties into the Hudson River on the west shore about 100 miles above the city of New York. With the exception of some slight works undertaken by the inhabitants, giving no permanent results, nothing had been done towards the improvement of this harbor until it was undertaken by the United States Government in 1887. In 1883 a survey of the harbor was made, under the direction of the engineer officer in charge, which indicated that there was a shoal at the entrance 1,100 feet wide, between 6-foot contours, over which the least depth was 3 feet mean low water. Two plans of improvement were recommended, both providing for the construction of parallel dikes, and for dredging the channel between them 7 feet deep, mean low water. (See Annual Report of the Chief of Engineers for 1884, Part I, page 716.)

A reëxamination of the harbor, made in 1887, after the State had done some dredging in the channel, resulted in the submission of a third project, differing from those previously submitted only in the direction to be given to the dikes. The range of tides is 4 feet approximately.

The project of 1887 was approved and its execution was begun the same year.

Its estimated cost was as follows (see Annual Report of the Chief of Engineers for 1887, Part I, page 662):

North Dike, 2,300 feet long:	
Pile work, 2,160 running feet, at $7 per foot	$15,120
Crib work, 140 running feet, at $30 per foot	4,200
South Dike, 2,300 feet long:	
Pile work, 2,200 running feet, at $7 per foot	15,400
Crib work, 100 running feet, at $30 per foot	3.000
Dredging, 30,000 cubic yards, at 25 cents	7,500
Contingencies, about 15 per cent	6,780
Total	52,000

At the close of the fiscal year ending June 30, 1890, under appropriations made in 1884, 1886, and 1888, aggregating $32,000, the South Dike had been completed its projected length of 2,363½ feet, and 809½ feet of the projected length of the North Dike had been built. The water way between them had also been dredged so as to afford a channel 100 feet wide and 9 feet deep mean low water from the inner harbor eastward to the Hudson River. The inner harbor had at that time, for a distance of 2,000 feet, a channel 150 feet wide and 14½ to 20 feet deep mean low water.

The width of the water way between the North and South Dikes, so far as constructed, is 260 feet. When the project is completed by the extension of the North Dike 1,260 feet to the light-house the width of the confined channel at the eastern end will be 325 feet.

In past years the channel at the entrance has shoaled up by reason of ice gorges which formed at the mouth before the ice broke up in the Hudson. The shoals formed in this way have been partially removed by subsequent spring freshets. The purpose of the dikes is to contract the channel, to promote the scour of the freshets, and to maintain the improved navigable depth during the low stage of summer, which usually lasts for two months approximately.

As the direct result of the improvements which have been made by the Government, vessels with a draft of 12 feet and upwards are now enabled to reach the factories at high tide.

The river and harbor act of September 19, 1890, appropriated $10,000 for continuing the improvement.

The amount required to complete the improvement in accordance with the approved project is $10,000.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

At the beginning of the fiscal year no work was in progress, as the appropriation of August 11, 1888, excepting a small balance, had been exhausted.

A project for the application of the appropriation of $10,000 of the act of September 19, 1890, was submitted September 24, 1890.

This project contemplated the construction of the extension of the North Dike towards the light-house. The project was approved, and proposals were invited by public advertisement October 15, 1890, and a contract for the construction of 1,000 feet, more or less, was entered into with William Parrott, the lowest bidder, December 17, 1890. The plan of construction is similar to that adopted for the dike already built, and will consist of two parallel rows of piles, driven 7 feet apart from out to out, sawed off at a height of 2 feet above mean high water, tied together with wooden cross-ties and iron tie-rods, and the space between filled with stone. Work under this contract was started on the 6th of April, and is now in progress.

Piles have been driven covering a distance of 1,188 feet and the square timber partly put on. Material used, 34,000 linear feet pine piles; 2,775 feet B. M. square timber, and 1,000 pounds iron.

While the specifications called for the construction of 1,000 feet more or less of dike the length actually to be built was made to depend on the price of the bid for the required material, so that it is expected that the whole length of 1,260 feet, extending to the light-house, can be completed with the present funds. Low prices were secured by advertising for bids in the fall, enabling the contractors to provide their material during the winter, when purchase of piles can be made at cheaper rates.

The channel of the creek between the light-house and steamboat wharf is covered in two places by rock formation. Nearly opposite the upper end of the crib dike built by the United States Government in 1889 are a few high points on which vessels at very low tide sometimes strike. They should be removed; but as the cost will be slight no special estimate therefor is submitted. With this exception the channel is in good condition. From the steamboat dock to deep water in the Hudson there is at present a channel width of 150 feet between the 9-foot curves.

The amount required to complete the improvement in accordance with the approved project is $10,000. An appropriation of $5,000 is recommended to maintain the dike in proper repair and to remove the rocky points near the shore end of North Dike.

Saugerties is in the collection district of Albany, N. Y., which is the nearest port of entry. The nearest light-house is at the mouth of Esopus Creek.

COMMERCIAL STATISTICS.

The commercial carriers are 5 steamboats for freight and passenger traffic, owned by the Saugerties and New York Steamboat Company, the Saugerties and Albany line, and the Saugerties, Rondout and Hudson line, and 405 sailing and other craft, the former carrying 17,000 passengers annually, and all in aggregate 189,000 tons of freight, valued at $5,484,000, the principal products being general merchandise, bluestone, coal, and lumber.

The population of Saugerties is 5,000.

AMOUNTS APPROPRIATED.

July 5, 1884	$5,000.00
August 5, 1886	15,000.00
August 11, 1888	12,000.00
September 19, 1890	10,000.00
Total	42,000.00
Amount expended to June 30, 1891, inclusive of outstanding liabilities	36,299.11

Money statement.

July 1, 1890, balance unexpended		$721.93
Amount appropriated by act approved September 19, 1890		10,000.00
		10,721.93
June 30, 1891, amount expended during fiscal year		3,043.69
July 1, 1891, balance unexpended		7,678.24
July 1, 1891, outstanding liabilities	$1,977.35	
July 1, 1891, amount covered by uncompleted contracts	3,078.83	
		5,056.18
July 1, 1891, balance available		2,622.06
Amount (estimated) required for completion of existing project		10,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		5,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for building a pile dike at Saugerties Harbor, New York, received in response to advertisement dated October 15, 1890, and opened November 19, 1890, by First Lieut. Harry Taylor, Corps of Engineers, in the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Pine piling, 35,000 linear feet.		Square timber, yellow pine, 32,000 feet B. M.		Tie rods and screw bolts, 11,700 pounds.	
		Per linear foot.	Amount.	Per 1,000 feet B. M.	Amount.	Per pound.	Amount.
1	Francis H. Smith	$0.14 2/10	$5,215.00	$57.00	$1,840.00	$0.05	$585.00
2	John D. Walsh	.15 3/8	5,381.25	38.00	1,216.00	.03	351.00
3	William Parrott	.11 3/8	3,981.25	38.00	1,216,00	.04	468.00
4	William Fuller & Sons	.11 3/4	4,112.50	40.00	1,280.00	.05 1/4	672.75
5	Frederick J. Kelly	.13	4,550.00	40.00	1,280.00	.06	702.00
6	James DuBois and Abraham DuBois	.14	4,900.00	35.00	1,120.00	.06	702.00

No.	Name of bidder.	Drift bolts, 320 pounds.		Broken stone, 2,200 cubic yards.		Total.
		Per pound.	Amount.	Per cubic yard.	Amount.	
1	Francis H. Smith	$0.05	$16.00	$1.15	$2,530.00	$10,186.00
2	John D. Walsh	.03 1/2	10.40	1.35	2,970.00	9,928.65
3	William Parrott*	.04	12.80	.94	2,068.00	7,746.05
4	William Fuller & Sons	.04 3/4	15.20	.88	1,936.00	8,016.45
5	Frederick J. Kelly	.05	16.00	1.05	2,310.00	8,858.00
6	James DuBois and Abraham DuBois	.05	16.00	1.00	2,200.00	8,938.00

* Lowest bid.

E 3.

IMPROVEMENT OF HARBOR AT RONDOUT, NEW YORK.

Rondout Harbor is formed by the mouth of Rondout Creek, which empties into the Hudson River on its west side about 90 miles above the city of New York.

From the entrance to the lock of the Delaware and Hudson Canal, a distance of 3 miles, the creek is a tidal stream, the range of tides being 4 feet, approximately.

Prior to 1871 improvements had been made by private persons and corporations, but no permanent benefit had been derived from them. In 1869 a survey of the harbor was made by the Government, with a view to its permanent improvement, and it was then found that the available depth of water in the channel was about 7 feet.

The project of improvement based upon this survey provided for the formation and maintenance of a channel 100 feet wide and 14 feet deep at the mouth of the creek, to be obtained by means of dredging and diking. Two parallel channel dikes were to be built outward, toward, and into the Hudson River, their outer ends curving gently downstream, while a branch dike, running upstream along the Hudson from the outer end of the north dike, was to protect that dike from destruction from running ice. The estimated cost of the work was as follows:

Building the north dike, 748 yards long	$41,600
Building the branch dike, 640 yards long	34,400
Building the south dike, 1,277 yards long	59,600
Dredging a channel 3,000 feet long, 100 feet wide, and 14 feet deep at low water, 48,000 cubic yards, at 30 cents	14,400
Contingencies	22,500
Total	172,500

The final length of the north and south dikes was, however, to be determined after observing the effects which they might produce in the removal of the bar as they were gradually extended outward. The work was begun in 1872 and was completed in 1880. It was found by experience that the dikes might be shortened so much below the lengths originally deemed necessary for them that the total cost of the work was reduced to $104,000, less than two-thirds of the original estimate.

On the completion of the work in 1880 the north dike was 2,200 feet, approximately, with a branch dike running up the Hudson 1,000 feet, approximately, and the south dike was 2,800 feet long, approximately, with a spur to the light-house 330 feet long. The distance between the dikes at the entrance was 350 feet, approximately. As the result of the works of improvement there was a channel 50 feet wide, giving 13½ feet, mean low water; 100 feet wide, giving 12 feet, mean low water, and 200 feet wide, giving 10 feet, mean low water, from the creek to the channel of the Hudson. At the outer end of the dikes the distance between the 12-foot curves was over 300 feet.

The north and branch dikes were originally built to the height of mean high water, while the south dike, for 500 feet west of the light-house, was built only to the level of half tide. The low part of the south dike was subsequently raised by crib work to mean high water, but even with this increased height the dikes are submerged during storm-tides, and freshets, and are required to be marked by fender piles to enable vessels to enter the harbor at such times without danger of being wrecked upon the concealed dikes.

The appropriations for this harbor, made since the completion of the works in 1880, have been applied exclusively to the repair of the dikes. The improved depths in the channel have been well maintained, but the dikes have greatly deteriorated, partly owing to the ice, partly to the natural decay of the timber, and partly to the undermining of the piles by scour.

The survey of the harbor made in September, 1889, indicated a continued improvement of the channel between the dikes, not in the enlargement of the width of the 14-foot channel, but in that of the 9-foot channel, which then had a width of 250 feet.

On the south side of the entrance there has been a slight shoaling, due probably to the removal in 1884 of 150 feet from the outer end of the south pier, to meet the wishes of the boatmen, who alleged that their tows required a wider entrance between the piers on that side when coming in with vessels on the flood tide. The change in length of the south dike doubtless facilitates entrance at flood tide, but the shoaling of the bar on that side, which is shown by the survey of 1889, makes it probable that the south dike should be increased rather than decreased in length.

The act of August 11, 1888, appropriated $5,000 for continuing the improvement, which was applied towards repairs of both dikes.

The river and harbor act of September 19, 1890, appropriated $5,000 for repairing existing works.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

No work was done in the fiscal year, as the funds appropriated by the act of August 11, 1888, were expended during the previous year.

The river and harbor act of September 19, 1890, made an appropriation of $5,000 for improving this harbor, which is to be applied in "repairing existing works."

The high stage of water which prevailed in the autumn and spring delayed until May an examination of the dikes with the view to the preparation of estimates for repairs below the low-water line. At that time it was found that the North Dike for a length of 550 feet was badly undermined and was canted over considerably towards the channel.

Sealed proposals for making the necessary repairs were invited by public advertisement according to law May 29, and will be opened July 2.

It is proposed to repair the undermined portion of the dike by driving a row of piles in front and in rear of the dike 2½ feet apart from center to center; to connect the piles in each row by adequate waling timbers; to bind the two rows together by iron tie-rods; and to supply stone to the dike or to riprap the foundation, as may be found necessary, within the limits of the appropriation.

The inside shoal referred to in the last annual report as located 1¾ miles west of the light-house was removed by the State of New York during the autumn. It was composed chiefly of rock, and was situated in midchannel, nearly opposite the wharves of the Delaware and Hudson Canal Company.

The channel is now in good navigable condition sufficient for the wants of commerce.

An appropriation of $10,000 is recommended to complete the necessary repairs to the dikes so as to make them comparatively permanent.

COMMERCIAL STATISTICS.

The commercial statistics of this harbor have not changed materially since report of last year, at which time there was a total tonnage of 2,467,490 tons, valued at $41,268,850. General merchandise, coal, cement, lime, bluestone, and ice are the principal products handled, and are carried in about 700 vessels, which also carry 75,000 passengers annually.

Of the above tonnage one-half passes through the Delaware and Hudson Canal, which connects the Hudson River at Rondout with the Delaware River at Port Jervis, N. Y., and with Honesdale, Pa., the heart of the Pennsylvania coal region.

The population of Rondout is 25,000.

Rondout is in the collection district of New York. The nearest works of defense are those in New York Harbor.

AMOUNTS APPROPRIATED.

By act of Congress approved—	
June 12, 1872, diking	$10,000.00
March 3, 1873, diking	20,000.00
Amount allotted June 8, 1875, from repairs of harbors on Atlantic Coast, repairs	762.18
From contingencies of rivers and harbors, etc., repairs	237.82
By act of Congress approved—	
August 14, 1876, diking and repairs	30,000.00
June 15, 1878, diking and dredging	30,000.00
By act of Congress passed August 12, 1882, repairs and dredging	2,000.00
By act of Congress approved—	
July 5, 1884, repairs and dredging	1,000.00
August 5, 1886	2,500.00
August 11, 1888, repairs	5,000.00
September 19, 1890, repairs	5,000.00
Total	106,500.00
Amount expended to June 30, 1891	101,500.00

Money Statement.

Amount appropriated by act approved September 19, 1890	5,000.00
July 1, 1891, balance unexpended	5,000.00
Amount (estimated) required for completion of existing project	20,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893	10,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.	

E 4.

IMPROVEMENT OF WAPPINGER CREEK, NEW YORK.

Wappinger Creek is a small stream which rises in the northern part of Dutchess County, N. Y., near the boundary with Columbia County, and after flowing for about 40 miles through a rich and fertile valley empties into the Hudson River on the east bank, one-half mile below the village of New Hamburg, N. Y.

It is navigable for vessels and small barges drawing not over 6 feet in a channel varying in width from 25 feet to 75 feet to Wappinger Falls, 2 miles approximately above its mouth, where a series of falls, with an aggregate height of 86½ feet above mean low water, furnish a valuable water power for three industries, the principal of which is the print works of the Dutchess Company.

The appropriation of $13,000 contained in the river and harbor act of September 19, 1890, is the first ever made by the Government for the improvement of the stream and is based upon the estimate contained in the report, November 11, 1889, upon the survey of Wappinger Creek from Wappinger Falls to its mouth, made to comply with the river and harbor act of August 11, 1888.

The project contemplated a channel 80 feet wide and 8 feet deep from the mouth to the head of navigation at the falls, and the quantity of material required to be excavated was estimated at 45,000 cubic yards.

The work was advertised according to law, and the sealed proposals were opened publicly November 19, 1890. The lowest bidder was Mr. Peter W. Myers, but as his proposal contained the proviso that the dredged material should be deposited in the river, near the entrance, in place of "behind secure bulkheads," where it could not be "reached or displaced by freshets," as the specifications required, it was rejected, after an ineffectual effort to find an acceptable dumping ground. The other proposals were excessive in price and were accordingly rejected.

While the acceptance of Mr. Myers's bid, which was considered reasonable in price, was pending, letters were written to all persons who could be supposed to be interested in the improvement of the creek, and the assistant engineer made a special investigation on the ground, in the hope that some riparian owner would offer, on reasonable terms, an adequate front on the shore for the deposit of the dredged material. No such owner could be found; in fact no one seemed to take any interest in having the existing navigable depths increased; and the general manager of the Dutchess Company stated in writing that the "deepening of the channel of said creek is unnecessary, and we would very much prefer not to have any dredging machine in the creek at present."

For these reasons, action looking to expenditure of the appropriation was temporarily suspended.

The work was again advertised June 8, 1891, and sealed proposals for the execution of the project will be opened July 16, 1891.

No further appropriation is recommended for this improvement, as the appropriation made by the river and harbor act of September 19, 1890, is for the full amount of the estimate contained in the report made on the original survey under the act of August 11, 1888.

Wappinger Creek is in the collection district of New York. The nearest works of defense are situated upon Governor Island, New York Harbor, and the nearest light-house is the Danskammer Point light-house.

AMOUNT APPROPRIATED.

September 19, 1890 ..... $13,000

Money statement.

Amount appropriated by act approved September 19, 1890	$13,000.00
June 30, 1891, amount expended during fiscal year	80.33
July 1, 1891, balance unexpended	12,919.67

Abstract of proposals for improving Wappinger Creek, New York, received in response to advertisement dated October 15, 1890, and opened November 19, 1890, by First Lieut. Harry Taylor, Corps of Engineers, U. S. A., in the official absence of Lieut. Col. G. L. Gillespie, U. S. A.

No.	Name of bidder.	Dredging per cubic yard.	Quantity that can be removed under available appropriation at price bid.	Amount.
		Cents.	*Cubic yards.*	
1	John Brown	29½	38,983	$11,499.99
2	Emory R. Seward	39½	29,114	11,500.03
3	James McSpirit	31	37,097	11,500.07
4	Peter W. Myers*	23	50,000	11,500.00
5	Richard Parrott	26½	43,396	11,499.94
6	Edgar M. Payn	59½	19,328	11,500.16

*Lowest bid; proposal informal.

COMMERCIAL STATISTICS.

The principal manufactures at the Falls are cotton goods, overalls, clothing, combs, and iron. They are mostly transported by small boats to the mouth of the creek, inside of the railroad bridge, where they are transferred to the New York Central and Hudson River Railroad.

The tonnage of the creek during the year 1888 was 70,000 tons. The value of the tonnage was then estimated at $6,500,000. The Dutchess Company shipped 15,500 tons, at an estimated valuation of $5,600,000. The traffic is principally carried by sloops, schooners, scows, canal boats, and barges.

E 5.

IMPROVEMENT OF HARLEM RIVER, NEW YORK.

The project for making a navigable water connection between the East River and the Hudson River by the way of the Harlem River and the Spuyten Duyvil Creek was formulated upon the facts determined by the survey made along this route in 1874, in compliance with the river and harbor act of June 23, 1874, the report upon which may be found at page 224, Annual Report of the Chief of Engineers for 1875, Part II.

This report contains an interesting historical review of the navigation of the Harlem River from the Revolution to the present time.

A full history of this improvement as now adopted, with the legal proceedings for the acquirement of the land needed for it and copies of the laws passed by the legislature of the State of New York relative thereto, is given in the annual report of the local engineer in charge to the Chief of Engineers for 1887. (See Annual Report of the Chief of Engineers for 1887, Part I, pages 665 to 689.)

The streams embraced in the improvement are the Harlem River and the Spuyten Duyvil Creek, the former emptying into the East River near Hell Gate, and the latter into the Hudson River about 13 miles north of the Battery, and together separating Manhattan Island from the mainland.

There has always been an exchange of waters between these two streams at Kingsbridge, though a long ledge of rocks awash at mean low water and an extremely narrow channel at that point have heretofore prevented the exchange being a free one.

High Bridge is practically at the head of navigation in the Harlem River, but there is a fair channel of about 10 feet depth at mean low water as far as Morris Dock, 6 miles from the mouth of the river, and a crooked one of 7 feet depth to Fordham Landing, 1 mile further; but there is no navigation of this entire section, except by row-boats and a few boats loaded with material for the new Croton aqueduct or for the roadway of streets which are being opened in the "annexed district." Kingsbridge, $1\frac{3}{4}$ miles from the Hudson River, is the head of navigation in the Spuyten Duyvil Creek, but only at high water, for vessels drawing 8 feet.

The range of the tides in Harlem River varies from 5.5 feet at Third Avenue Bridge to 6 feet at the mouth of Dyckman Creek, and in the Spuyten Duyvil Creek is 3.8 feet.

As the difference in the height and times of tides between the East and Hudson Rivers, after the connection is made between the Harlem and the Hudson Rivers, will produce the currents upon which reliance is placed to keep the channel open, it is desirable that the cross-section of the channel be kept as uniform as possible, in order to avoid the unnecessary resistances to the flow of the water which would be caused by any contraction of the waterway.

The contraction of the proposed cut through Dyckman Meadows will be more than counterbalanced by the natural channel through Spuyten Duyvil by the way of Kingsbridge, which is left open, and the contraction caused by the piers and embankments of the High Bridge, which carries the Croton aqueduct across the Harlem River, should be counteracted by deepening the channels between the piers and abutments. Observations of the tides affecting these waters show that there is not a free exchange of tides between Harlem River and Spuyten Duyvil Creek, but that there is practically a divide somewhere near Fordham Bridge between the tides flowing from the East River into the Harlem River, and from the Hudson River into Spuyten Duyvil Creek. Comparing the tides of the Harlem River at Fordham Bridge with those of the Hudson River at the mouth of Spuyten Duyvil Creek, it is found—

(1) That the level of mean high water in the Hudson is nearly 1 foot (.961 foot) lower than it is in the Harlem.

(2) That the mean rise and fall of the tide in the Hudson is 2.12 feet less than it is in the Harlem.

(3) That the mean duration of the rise of tides in the Hudson is 36 minutes shorter, and the mean duration of the fall 26 minutes longer, than in the Harlem.

(4) The mean level of the Hudson at the mouth of Spuyten Duyvil Creek is .265 of a foot lower than at Fordham Bridge.

(5) High water occurs 1 hour and 34 minutes earlier in the Hudson than in the Harlem.

From these facts it follows that while there will at different times be

a flow toward either river, the preponderance of flow will be toward the Hudson, and the scour will go that way, so that if a cut for a free passage of the tides be made, the opening into the Hudson will become the mouth of the cut.

The project for the improvement was adopted in 1879. The proposed lines of improvement, as laid down by the engineer in charge in his annual report for 1882, are as follows:

(1) Below the Harlem or Third Avenue Bridge the outer pier and bulkhead lines as laid down by the Park Department are adopted.

(2) Above the Third Avenue Bridge to the entrance of Dyckman Creek into the Harlem River, the exterior pier and bulkhead lines are laid down 400 feet apart.

(3) The line following Dyckman Creek through Dyckman Meadows will pass for a part of the way through solid rock, and it is here that the principal cost of the undertaking must be encountered. This part is to be made 350 feet wide. It would have been preferable to establish it at 400 feet, but the additional amount of rock excavation was the obstacle.

(4) The remainder of the line to the Hudson River will follow as nearly as possible the course of the Spuyten Duyvil, and the width will be 400 feet.

(5) The channel depth in the Harlem River and Spuyten Duyvil Creek will be 15 feet at mean low water, and in the channel along Dyckman Creek 18 feet, mean low water.

The estimated cost of making the connection by a cut through Dyckman Meadows, as giving by General Newton in his report for 1882, is $2,100,000.

This estimate does not provide for the improvement of the channel of the Harlem River between this proposed cut and the mouth of the Harlem River.

The estimated cost of improving this part of the river, as given in General Newton's report for 1875, was about $600,000. Total for the improvement of the Harlem River between the Hudson River and East River, $2,700,000.

The project was revised in 1886 by narrowing the channel immediately north of High Bridge to 375 feet, where it skirts the Ogden estate on the east bank. This change of width was approved by the Secretary of War October 7, 1886. (See Annual Report of the Chief of Engineers for 1887, Part I, page 671.)

The estimated cost of opening the channel from the Harlem River to the East River by the way of the Harlem or Bronx Kills, making it 300 feet wide and 15 feet deep at low water, was about $2,200,000. This survey was ordered by act of Congress approved March 3, 1881, and the report upon it is to be found in the Annual Report of the Chief of Engineers for 1882, Part I, page 656.

After the legal difficulties for acquiring the right of way along the line of the proposed improvement of the Harlem River were removed in May, 1887, the appropriations of 1878 and 1879, aggregating $400,000, became available, and a project for their expenditure was made very soon thereafter.

Work was begun, under the first contract for earth and rock excavation along Dyckman Creek, in January, 1888, and has continued uninterruptedly since that date.

Contracts have also been made covering the appropriation of $70,000, act of August 11, 1888, and that of $250,000, act of September 19, 1890.

These several contracts provide for the excavation of all the material contained between the dams; the removal of the dams; the revetment of both banks for short distances east and west of both dams; and for dredging a channel from the east dam through the Harlem River to Fordham Dock, and from the west dam to Spuyten Duyvil Creek. It is expected that when these contracts are completed there will be a narrow channel between the Hudson and the East Rivers navigable at mean low water by vessels drawing 8 feet.

BRIDGES ACROSS THE HARLEM RIVER.

The Board of Engineers convened May 7, 1890, to consider, as stated in the last annual report, the matter of the bridges across the Harlem River at Third and Fourth avenues, New York City, submitted a report to the Chief of Engineers June 19, 1890, in which it was recommended that the bridges, having been found to be obstructions to the free navigation of "a navigable water way of the United States," "by reason of insufficient height and insufficient width of spans," in the sense in which the words are used in section 9 and section 10 of the river and harbor act of August 11, 1888, be made to conform as nearly as practicable to the requirements of the State legislation of 1879 for new bridges over the Harlem River.

This recommendation was approved by the Secretary of War June 23, 1890, and the city of New York, owning or controlling the bridge at Third avenue, and the New York Central and Hudson River Railroad Company, owning or controlling the bridge at Fourth avenue, were notified that the required modification should be made by January 1, 1892.

On March 4, 1891, Mr. Alexander J. Howell made complaint to the Secretary of War that the railroad bridge across the Spuyten Duyvil Creek at its mouth was an obstruction to navigation by reason of "insufficient width of draw," under the river and harbor act of September 19, 1890.

The matter was referred to this office, and two public hearings were given to the parties in interest.

The complaint was satisfied by the New York Central and Hudson River Railroad Company agreeing, as a temporary measure only, to widen the draw opening to 50 feet, and to erect a steam motor with which to maneuver the drawbridge. This agreement was approved by the Secretary of War June 9, 1891, with the proviso that the modification agreed upon should be regarded as a temporary measure to meet the necessities of the navigation of that stream as they now exist, and the date fixed for the completion of the alteration was December 1, 1891.

By the State act of April 29, 1890 (found in the appendix), the department of public parks, New York City, was authorized to reconstruct the McComb Dam Bridge at Seventh avenue. The act provides that the bridge shall be constructed in conformity with the general provisions of the State law of 1882, with the difference that it shall have a height of "not less than 30 feet above mean high-water mark of said river," instead of "not less than 24 feet above the high water of spring tides," as provided in the act of 1882. The provision for the height of the lower chord being favorable for navigation, the consent of the Secretary of War to the construction of the bridge under the act was given June 23, 1890. The work of reconstruction is now in progress.

The following table shows the location and characteristics of the several bridges across the Harlem River:

Name and location of bridge.	Width in clear in each draw.	Height of bottom chords above mean high water.	Remarks.
	Feet.	*Feet.*	
Second Avenue	103.7	28.5	Double draw, railroad bridge, iron.
Third Avenue	82.0	13.8	Double draw, road bridge, iron.
Fourth Avenue	65.0 / 68.0	7.2	Double draw, railroad bridge, iron.
Madison Avenue	132.0	28.0	Double draw, road bridge, iron.
McComb Dam	80.0	36.7	Double draw, road bridge, wood and iron; soon to be reconstructed.
New York and Northern Railway Bridge.	128.0	28.0	Double draw, railroad bridge, iron.
High Bridge (Old Aqueduct)	.....	.....	No draw; width in clear between piers, 77.7 feet; intrados of arch, 100 feet above mean high water.
Washington Bridge, at One Hundred and Eighty-first street (single span).	.....	.....	No draw; iron arch; clear span, 500 feet; crown of arch, 136.7 feet above mean high water.
Footbridge, Fordham	32.0	3.9	Single draw; wooden trestle; soon to be removed.
Farmers' Bridge	.....	3.1	No draw; two spans, 22 and 23 feet wide.
Kings Bridge	.....	4.8	No draw; two spans, 18 and 25 feet wide.
Hudson River Railroad Bridge, mouth of Spuyten Duyvil Creek.	26.2	1.4	Single draw; wooden trestle; to be provided soon with a draw opening 50 feet wide and a steam motor for operating drawbridge.

The amount expended at the close of the fiscal year ending June 30, 1890, inclusive of outstanding liabilities, was $367,060.22.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

At the beginning of the year two contracts were in force with Mr. John Satterlee. The first, dated December 15, 1887, calls for the removal of 300,000 cubic yards of material from the cut through Dyckman Meadow, and the second, dated August 12, 1889, for the removal of 71,000 cubic yards of earth and 19,000 cubic yards of rock, and for building an earthen and timber dam to shut out the water of the Harlem River from the site of the work to be done under this contract.

The section of canal prism to be excavated under the first contract lies to the west of the old Kingsbridge road, and that to be excavated under the second contract lies partly east and partly west of the same road. Between these two contracts there remained a section, containing about 43,000 cubic yards of material, to be excavated to complete the improvement between the two dams.

By the river and harbor act of September 19, 1890, $250,000 was appropriated for continuing the improvement. Under this appropriation three additional contracts were entered into after inviting sealed proposals according to law.

First. For excavating and removing about 37,000 cubic yards of rock and 7,000 cubic yards of earth from the section lying between the two sections of canal prism already under contract. Mr. James Coleman was the lowest bidder under this section, and the work was awarded to him; but, on his failure to sign the contract when presented to him for signature, the award was canceled, and a contract was finally made with Mr. John Satterlee, on March 9, 1891, at the prices bid by Mr. Coleman.

Second. For removing the eastern cofferdam, containing about 30,000 cubic yards of earth, stone, and timber work; for dredging about 65,000 cubic yards of mud, clay, and sand from the meadow and old creek bed east of the dam; for dredging 180,000 cubic yards, more or less, of earth and mud from the shoal reach in the Harlem River between the easterly limit of the cut through Dyckman Meadow and Fordham Footbridge; and for constructing about 350 linear feet of cribwork and about 200 linear feet of pilework revetment for the protection of the sides of the section of cut to be excavated. Mr. Lee McCallum was the lowest bidder under this section, and a contract was made with him December 29, 1890.

Third. For removing the western cofferdam, containing about 40,000 cubic yards of earth, stone, and timber work; for dredging about 160,000 cubic yards of mud and earth from the meadow and creek bed west of the dam; and for constructing about 300 linear feet of cribwork and 250 linear feet of pilework revetment for the protection of the sides of the section of cut to be excavated. The work under this section was awarded to Mr. P. Sandford Ross, the lowest bidder, and a contract was made with him January 19, 1891.

Under authority granted by the Chief of Engineers, June 18, 1890, an open-market agreement was also made with Mr. John Satterlee for the construction of about 2,870 cubic yards of stone revetment wall for the protection of the side slopes in the westerly end of the cut through Dyckman Meadow, the wall to be built of stone taken from the excavation and to be laid partly dry and partly in cement mortar, as circumstances might require. The prices agreed upon were $2.50 per cubic yard for dry-stone wall and $6 per cubic yard for wall laid in mortar.

The first contract with Mr. Satterlee, dated December 15, 1887, expired on December 31, 1890, and the second, dated August 12, 1889, expired on June 30, 1891. On the application of the contractor both contracts were extended by direction of the Chief of Engineers, the first to September 30, 1891, and the second to December 1, 1891.

Under the foregoing contracts and agreements, the following work was done during the fiscal year:

Under the contract dated December 15, 1887, 25,448 cubic yards of material were removed, of which 2,158 cubic yards were excavated from above the plane of mean low water and 23,290 cubic yards from below that plane, making the total amount of material removed up to date 289,960 cubic yards.

Under the contract of August 12, 1889, 398 cubic yards of rock and 44,831 cubic yards of earth and turf were excavated and removed, making the total amount of material removed under this contract up to date as follows, viz:

	Cubic yards.
Earth and mud dredged	11,000
Earth excavated	46,379
Rock excavated	398

Under the contract of March 9, 1891, work was begun on April 1, and at the close of the year 5,593 cubic yards of earth and 2,089 cubic yards of rock had been removed.

Dredging in the Harlem River, under the contract with Mr. Lee McCallum, dated December 29, 1890, was begun on May 18, 1891, and at the close of the year 40,204 cubic yards of material had been removed from the river channel above Fordham Footbridge.

Under the contract of January 19, 1891, with Mr. P. Sanford Ross, the contractor is building a dredge and scows specially adapted to this

work, which will be completed in a short time, when work under this contract will be commenced.

As soon as grade was reached in the rock excavation in the west end of the cut through Dyckman Meadow, the construction of a section of revetment wall to retain the side slope of the cut, where the cutting was through earth and loose stone, was begun, and the wall extended from time to time as the excavation of the canal prism progressed. During the year a total of 692 cubic yards of wall was built, all on the north side of the cut. The section of wall completed has a length of 90 feet, and rises to 9 feet above mean low water.

The progress of the work under Mr. Satterlee's first and second contracts was retarded to a considerable extent by the flooding of the pits during a heavy freshet on October 24, 1890. On that date, during an easterly storm of unusual violence when the tide rose to a greater height than any observed since the beginning of the improvement, a breach was effected in the west dam, through which the water of Spuyten Duyvil Creek entered the pit with great velocity, entirely filling it to the creek level. As the water rose in the pit to the west of Kingsbridge road, it gradually found its way through the bed of the old Dyckman Creek into the pit on the east side of this road and soon flooded it. The east dam, although nearly submerged, remained practically uninjured, but the tide water passing through a depression in the temporary roadway connecting the east dam with the old Kingsbridge road, attacked the sheet piling which retained the meadow bank on the north side of the pit, and forced it slightly out of line. The damage here was, however, slight, and was repaired without delay. To repair the breach in the west dam, and free the west excavation of water, was a work of much greater magnitude, the difficulties being greatly augmented by the approaching winter season, which proved of unusual severity, and it was not until March, 1891, that the excavation of material from this section of the work was resumed.

The inclement weather of the past winter also greatly interfered with the work under Mr. Satterlee's second contract. The wet condition of the pits and muddy roads resulting from the frequent rain and snow storms made it impracticable to excavate and haul away material from the cut, and frequently caused a partial or total suspension of operations.

By the terms of Mr. Satterlee's contracts he is required, during the continuance of his work, to maintain and repair the cofferdams at the easterly and westerly limits of the cut through Dyckman Meadow, and in accordance with this requirement the injuries sustained by the dams were repaired, and the water pumped from the excavations without cost to the Government. When the water of Spuyten Duyvil Creek broke over and through the west dam, however, a large quantity of the meadow sod and mud lying between the creek and the dam was washed into the west end of the pit, covering the rock yet to be excavated there to a depth of several feet in places. As it was necessary to remove this material before the rock excavation could be resumed, a supplementary agreement to the contract of December 15, 1887, was made for its removal March 12, 1891, at 90 cents per cubic yard, and at the close of the year nearly all of this foreign material, measuring 9,506 cubic yards, had been removed.

As the result of the year's work, the excavation of the section of canal prism lying to the west of the old Kingsbridge road was carried down to grade over an area of 57,465 square feet, giving a total area of

203,575 square feet where the excavation has reached grade, and completing the section of the cut to be excavated under the contract of December 15, 1887, with the exception of a core of rock left standing in the center of the excavation for temporary use as a roadway, and a spur of rock in the southwest end, over which the tramway for transporting the broken stone to the dumping ground passes. Both these ledges cover an area of 42,000 square feet, and are now in process of removal. The old Kingsbridge road, where it crosses the canal, has been closed, and the material composing it excavated down to the underlying rock surface, and a temporary roadway over the east dam has been opened to public traffic. The earth, turf, and meadow sod between the east dam and the westerly limit of the contract of August 5, 1889, has been nearly all excavated down to grade, and the rock excavation begun and grade reached over an area of 600 square feet.

Nearly all the rock to be removed under the contract of March 9, 1891, has been stripped of earth, and the excavation in the rock has been carried down to grade over an area of 1,400 square feet. The dredging in the Harlem River began near Fordham foot bridge, and was carried northward towards Kingsbridge in a water way 600 feet long, 75 to 150 feet wide, and 9 feet deep, at mean low water. The quantity removed to the close of the fiscal year was 40,204 cubic yards.

Owing to the peculiar stratification of the rock and the many seams and cracks running through it, the sides of the cut between the dams are very irregular and jagged. To provide more regular and permanent sides to the canal chamber, and to prevent the loose rock and earth arising from degradation of the slopes from falling into it after the canal has been opened to navigation, it would be desirable to revet both sides of the cut from end to end with a substantial wall of masonry. Provision has already been made for the construction of detached sections of such a wall at the east and west ends of the cut, where transit from earth to rock cutting is made, and an estimate is now submitted for uniting the detached sections and making the walls continuous from dam to dam.

In excavating the canal prism the rock has generally been broken up and removed beyond the established improvement lines. On the north side the face of the cut is outside of these lines an average distance of about 4½ feet; and on this side a wall of sufficient thickness can be built directly on the canal line by removing a few projecting points of rock, some of which are loose and will not require drilling and blasting. On the south side it will be necessary to locate the wall one foot inside of the established line, in order that the wall may be given sufficient thickness without removing any considerable amount of rock from the face of the cut. It is proposed to construct the wall of stone taken from the excavation and laid in cement mortar. The wall will have an average thickness of about 4 feet, and its rear face will in all cases head directly against the rock face behind it. It will in general rise to 9 feet above low water, making the wall 27 feet high, except where the rock sides of the cut are overlaid by a considerable thickness of earth and land slides are apt to occur; at such places it is proposed to build the wall as much higher as may be necessary to intercept the earth slope at its natural angle of repose, for which purpose it will not be necessary to carry the wall higher than about 12 feet above low water at any part of its length. The total length of wall required, in addition to that already provided for at the east and west ends of the cut, is 700 linear feet on the north side and 600 feet on the south side.

The estimated cost of the additional wall required, should the same

be made continuous on both sides of the cut from end to end, is as follows:

North side of cut:	
700 linear feet of wall, 4½ feet thick (3,200 cubic yards, at $7)	$22,400
Removing projecting points of rock (80 cubic yards, at $1.50)	120
South side of cut:	
600 linear feet of wall, 4 feet thick (2,400 cubic yards, at $7)	16,800
Removing projecting points of rock (150 cubic yards, at $1.50)	225
Total	39,545

This improvement can not be well or economically conducted except under large appropriations. The amount that can be profitably expended during the fiscal year ending June 30, 1893, is $500,000.

A full statement of the commerce likely to be benefited by the improvement is subjoined.

Mr. A. Doerflinger, assistant engineer, has been in local charge of this improvement during the year. He has remained constantly upon the work, and has discharged his duties with his accustomed fidelity and efficiency.

Harlem River is in the collection district of New York. The nearest light-house is on Blackwell Island.

AMOUNTS APPROPRIATED.

June 23, 1874, allotment from appropriations for East and Harlem Rivers		$11,000.00
By act of Congress approved—		
March 3, 1875		10,000.00
June 18, 1878		300,000.00
March 3, 1879		100,000.00
August 11, 1888		70,000.00
September 19, 1890		250,000.00
		741,000.00
Amount expended to June 30, 1891, inclusive of outstanding liabilities.		$448,696.28

Money statement.

July 1, 1890, balance unexpended		$163,848.51
Amount appropriated by act approved September 19, 1890		250,000.00
		413,848.51
June 30, 1891, amount expended during fiscal year		71,549.56
July 1, 1891, balance unexpended		342,298.95
July 1, 1891, outstanding liabilities	$49,995.23	
July 1, 1891, amount covered by uncompleted contracts	271,801.42	
		321,796.65
July 1, 1891, balance available		20,502.30
Amount (estimated) required for completion of existing project		1,980,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		500,000.00

Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.

Abstract of proposals for improving Harlem River, New York, received in response to advertisement dated October 15, 1890, and opened November 26, 1890, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

SECTION NO. I. (BETWEEN SECTIONS ALREADY UNDER CONTRACT.)

No.	Name of bidder.	Rock excavation, 37,000 cubic yards.		Earth excavation, 7,000 cubic yards.		Total amount.
		Price per cubic yard.	Amount.	Price per cubic yard.	Amount.	
1	Clinton Stephens	$1.25	$46,250.00	$0.30	$2,100.00	$48,350.00
2	P. Sanford Ross	------	----------	------	----------	----------
3	Ben F. Coleman	.80	29,600.00	.40	2,800.00	*32,400.00
4	Lee McCallum	1.35	49,950.00	.35	2,450.00	52,400.00
5	James D. Leary	------	----------	------	----------	----------
6	John Satterlee	1.24	45,880.00	.30	2,100.00	47,980.00

*Lowest bid for Section No. I.

NOTE.—The lowest bidder having failed to sign articles of agreement, contract was made with Mr. John Satterlee, at the prices bid by Mr. Coleman.

SECTION NO. II. (EASTERLY.)

No.	Name of bidder.	Dredging.				Crib work (framed and sunk), 300,000 cubic feet.	
		Removing east cofferdam, 30,000 cubic yards.		East of dam and Harlem River, 285,000 cubic yards.			
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic foot.	Amount.
1	Clinton Stephens	$0.45	$13,500.00	$0.34	$96,900.00	$0.05	$15,000.00
2	P. Sanford Ross	.41	12,300.00	.33	94,050.00	.03	9,000.00
3	Ben F. Coleman	------	----------	------	----------	------	----------
4	Lee McCallum	.38	11,400.00	.28	79,800.00	.04	12,000.00
5	James D. Leary	.39	11,700.00	.32	91,200.00	.02¼	6,750.00
6	John Satterlee	.45	13,500.00	.30	85,500.00	.04	12,000.00

No.	Name of bidder.	Pile driving, 9,000 linear feet.		Round timber, 86,000 linear feet.		Square timber, 49,000 feet B. M.		Iron tie rods, screw bolts, etc., 28,000 pounds.	
		Per linear foot.	Amount.	Per linear foot.	Amount.	Per M. feet B. M.	Amount.	Per pound.	Amount.
1	Clinton Stephens	$0.08	$720.00	$0.10	$8,600.00	$45.00	$2,205.00	$0.08	$2,240.00
2	P. Sanford Ross	.10	900.00	.07	6,020.00	42.00	2,058.00	.05	1,400.00
3	Ben F. Coleman	------	----------	------	----------	------	----------	------	----------
4	Lee McCallum	.18	1,620.00	.07	6,020.00	34.00	1,666.00	.10	2,800.00
5	James D. Leary	.19	1,710.00	.06½	5,590.00	45.00	2,205.00	.04	1,120.00
6	John Satterlee	.15	1,350.00	.08	6,880.00	40.00	1,960.00	.06	1,680.00

No.	Name of bidder.	Stone filling.				Total amount stone furnished by contractor.	Total amount Government stone used.
		Furnished by contractor, 8,000 cubic yards.		Government stone used, 8,000 cubic yards.			
		Per cubic yard.	Amount.	Per cubic yard.	Amount.		
1	Clinton Stephens	$1.25	$10,000.00	$1.35	$10,800.00	$149,165.00	$149,965.00
2	P. Sanford Ross	.70	5,600.00	.70	5,600.00	131,328.00	131,328.00
3	Ben F. Coleman	------	----------	------	----------	----------	----------
4	Lee McCallum	1.10	8,800,00	.80	6,400.00	*124,106.00	121,706.00
5	James D. Leary	.70	5,600.00	.80	6,400.00	125,875.00	126,675.00
6	John Satterlee	.60	4,800.00	.60	4,800.00	127,670.00	127,670.00

*Lowest bid for Section No. II.

Abstract of proposals for improving Harlem River, New York, etc.—Continued.

SECTION NO. III. (WESTERLY.)

No.	Name of bidder.	Dredging.				Crib work, 240,000 cubic feet.	
		Removing west cofferdam, 40,000 cubic yards.		West of dam and Spuyten Duyvil Creek, 160,000 cubic yards.			
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic foot.	Amount.
1	Clinton Stephens	$0.45	$18,000.00	$0.34	$54,400.00	$0.05	$12,000.00
2	P. Sanford Ross	.40	16,000.00	.30	48,000.00	.03	7,200.00
3	Ben F. Coleman						
4	Lee McCallum	.38	15,200.00	.28	44,800.00	.04	9,600.00
5	James D. Leary	.39	15,600.00	.32	51,200.00	.02¼	5.400.00
6	John Satterlee	.45	18,000.00	.30	48,000.00	.04	9,600.00

No.	Name of bidder.	Pile driving, 12,000 linear feet.		Round timber, 75,000 linear feet.		Square timber, 50,000 feet B. M.		Iron tie rods, screw bolts, etc., 21,000 pounds.	
		Per linear foot	Amount.	Per linear foot.	Amount.	Per M feet B. M.	Amount.	Per pound.	Amount.
1	Clinton Stephens	$0.08	$960.00	$0.10	$7,500.00	$45.00	$2,250.00	$0.08	$1,680.00
2	P. Sanford Ross	.10	1,200.00	.07	5,250.00	42.00	2,100.00	.05	1,050.00
3	Ben F. Coleman								
4	Lee McCallum	.18	2,160.00	.07	5,250.00	34.00	1,700.00	.10	2,100.00
5	James D. Leary	.19	2,280.00	.06½	4,875.00	45.00	2,250.00	.04	840.00
6	John Satterlee	.15	1,800.00	.08	6,000.00	40.00	2,000.00	.06	1,260.00

No.	Name of bidder.	Stone filling.				Total amount stone furnished by contractor.	Total amount, Government stone used.
		Furnished by contractor, 8,500 cubic yards.		Government stone used, 8,500 cubic yards.			
		Per cubic yard.	Amount.	Per cubic yard.	Amount.		
1	Clinton Stephens	$1.25	$10,625.00	$1.35	$11,475,00	$107,415.00	$108,265.00
2	P. Sanford Ross	.70	5,950.00	.70	5,950.00	*86,750.00	*86,750.00
3	Ben F. Coleman						
4	Lee McCallum	1.20	10,200.00	.80	6,800.00	91,010.00	87,610.00
5	James D. Leary	.70	5,950.00	.80	6,800.00	88,395.00	89,245.00
6	John Satterlee	.60	5,100.00	.60	5,100.00	91,760.00	91,760.00

* Lowest bid for Section No. III.

Tabular statement showing revised bids for the improvement of Harlem River, New York, Section II, by Lee Mc Callum, James D. Leary, and P. Sanford Ross.

SECTION No. II. (EASTERLY.)

No.	Name of bidder.	Dredging.				Crib work, 300,000 cubic feet.	
		Removing east coffer dam, 30,000 cubic yards.		East of dam and Harlem River, 285,000 cubic yards.			
		Per cubic yard.	Amount.	Per cubic yard.	Amount.	Per cubic ioot.	Amount.
1	Lee McCallum	$0.38	$11,400.00	$0.28	$79,800.00	$0.04	$12,000.00
2	James D. Leary	.38	11,400.00	.27¾	79,087.50	.03¾	11,250.00
3	P. Sanford Ross	.40	12 000.00	.30	85,500.00	.03	9,000.00

Tabular statement showing revised bids, etc.—Continued.

SECTION NO. II. (EASTERLY.)—Continued.

No.	Name of bidder.	Pile driving, 9,000 linear feet.		Round timber, 86,000 linear feet.		Square timber, 49,000 feet, B. M.		Iron tie rods, screw bolts, etc., 28,000 pounds.	
		Per linear foot.	Amount.	Per linear foot.	Amount.	Per M. feet, B. M.	Amount.	Per pound.	Amount.
1	Lee McCallum	$0.18	$1,620.00	$0.07	$6,020.00	$34.00	$1,666.00	$0.08	$2,240.00
2	James D. Leary	.18	1,620.00	.07	6,020.00	44.00	2,156.00	.05	1,400.00
3	P. Sanford Ross	.10	900.00	.07	6,020.00	42.00	2,058.00	.05	1,400.00

No.	Name of bidder.	Stone filling.				Total amount stone furnished by contractor.	Total amount Government stone used.
		Furnished by contractor, 8,000 cubic yards.		Government stone used, 8,000 cubic yards.			
		Per cubic yard.	Amount.	Per cubic yard.	Amount.		
1	Lee McCallum	$1.10	$8,800.00	$0.75	$6,000.00	$123,546.00	$120,746.00
2	James D. Leary	.70	5,600.00	.70	5,600.00	118,533.50	118,533.50
3	P. Sanford Ross	.70	5,600.00	.70	5,600.00	122,478.00	122,478.00

NOTE.—Award made in accordance with original proposals.

COMMERCIAL STATISTICS.

As there is no navigable communication between the Harlem River and Spuyten Duyvil Creek, the present navigation of the Harlem River is practically confined to that part of the stream between its junction with the East River and Fordham Heights Dock, a distance of about 7 miles.

Spuyten Duyvil Creek is navigable from its junction with the Hudson River to Kingsbridge, a distance of 1¾ miles.

The actual commerce of the Harlem River and Spuyten Duyvil Creek for the fiscal year ending June 30, 1889, and June 30, 1890, was as follows:

Items.	1889.	1890.	
	Tons.	*Tons.*	
General merchandise	1,259,516	1,379,334	$93,114,135
Grain, flour, etc	341,167	400,987	11,325,607
Lumber	292,500	346,858	5,866,283
Building material	535,766	642,922	2,287,600
Fuel	523,290	508,365	2,464,800
Ice	131,700	112,000	448,000
Total	3,093,939	3,384,466	115,506,425

The total tonnage for the year 1890 shows an increase over that of 1889 of 290,527 tons, or over 9 per cent.

The total tonnage for the year 1887 was given at 2,524,155 tons, showing an increase in the present tonnage over that of 1887 of 860,311 tons, or 34 per cent., in 3 years.

Of the total tonnage for 1890, 1,407,882 tons were received at and shipped from the docks of the New York, New Haven and Hartford Railroad Company, directly below Second Avenue Bridge, and 246,402 tons were handled by the New York and Northern Railway Company at their docks near High Bridge. Of the balance, 1,709,632 tons were distributed among the various docks on the Harlem River between Ninety-second street and Fordham Heights, and 20,550 tons at various points on the Spuyten Duyvil Creek.

A large proportion of the freight handled at the railroad docks is carried in and out of the Harlem on railroad car floats and transfer boats connecting the railroads

of New Jersey and Pennsylvania, terminating at Weehawken, Hoboken, and Jersey City, with those of New England, while the general commerce of the river is carried on mainly in barges and canal boats in tow of steam tugs, and in schooners and the smaller class of sailing vessels.

So far as can be learned from present investigation and inquiries it appears that the increase in tonnage during the year 1891 has been fully up to the average increase during the last 4 years, indicating a present annual tonnage of near 3,750,000 tons.

CHAP. 207.—AN ACT to provide for the construction of a bridge over the Harlem River in the city of New York.

Became a law without the approval of the governor, in accordance with the provisions of article 4, section 9, of the constitution, April 29, 1890. Passed, three-fifths being present.

The people of the State of New York, represented in senate and assembly, do enact as follows:

SECTION 1. The commissioners of public parks of the city of New York are hereby authorized to erect and construct of stone, iron, or steel, or of one or more of these materials, a suitable bridge and approaches thereto, with the necessary abutments and arches over adjacent streets or avenues, for the passage of persons, animals, vehicles, and traffic across the Harlem River in said city connecting the improvements provided for by chapter five hundred and seventy-six of the laws of eighteen hundred and eighty-seven, with Seventh and Jerome or Central avenues, or with one or both of those avenues, at such points on said avenues as the commissioners shall ascertain and determine to be most practicable, and to make such changes in the grade lines of the streets or avenues approaching said bridge as may be necessary to carry out the purpose of this act, and for the proper construction of the improvement hereby authorized. Said bridge shall replace the present Central or Macomb Dam Bridge, and shall in its width for passage be not less than sixty feet, and the grade thereof shall be at an elevation not less than thirty feet above mean high-water mark of said river, and shall be otherwise constructed in conformity with the general provisions of law contained in section six hundred and seventy-six, chapter thirteen, of chapter four hundred and ten of the laws of eighteen hundred and eighty-two, regulating the construction of bridges over the Harlem River and Spuyten Duyvil Creek. Said bridge shall always be free for the passage of persons, animals, vehicles, and traffic, but no horse, cable, or other car track or railway shall be permitted on said bridge, and when completed shall be kept and maintained in good order and repair by the department of public parks in said city; provided, however, that nothing shall be done under this act until the plans and specifications for the said bridge and approaches thereto, with the necessary abutments and arches as aforesaid, as well as the proposed changes hereby authorized in the grade lines of the streets or avenues approaching the said bridge shall have been submitted to and approved by the board of estimate and apportionment of said city.

2. The said commissioners of public parks shall, upon such approval by the board of estimate and apportionment, proceed to construct the said bridge and approaches thereto, with the necessary abutments and arches, as aforesaid, and the same shall be completed within three years from the time of such approval. The work of constructing the said bridge and approaches thereto, with the necessary abutments and arches, as aforesaid, and the furnishing of all the material and labor necessary therefor, shall be done by contract, made at public letting, to the lowest bidder, pursuant to the general provisions of law and ordinance regulating the letting of contracts in said city.

3. The expense of constructing the said bridge and approaches thereto, with the necessary abutments and arches, as aforesaid, shall not exceed one million two hundred and fifty thousand dollars, and such further sum for paying awards for damages caused by reason of the change of grade of streets or avenues approaching the same, authorized by this act, as may be awarded by the board of assessors of the said city, whose duty it shall be to estimate the damage which each owner of land fronting on such street or avenue will sustain by reason of such change to such land, or to any improvements thereon, and make a just and equitable award to the amount of such damage to the owner or owners of such lands or tenements fronting on such street or avenue and opposite thereto and affected by such change of grade. The comptroller of said city shall from time to time, when directed by the board of estimate and apportionment, prepare and issue bonds of said city bearing interest at not more than four per cent. per annum, and redeemable from time to time, but not less than twenty years after the date thereof, for the purpose of defraying the expense of constructing the said bridge and approaches thereto, with the necessary abutments and arches, as aforesaid, and for paying the awards which may be made for damages by reason of any change of grade, as aforesaid. Such bonds shall not be sold for less than the par value thereof, and the moneys received from the sale of the said bonds

shall be deposited in the treasury of the said city, and shall be drawn and paid by the comptroller of the said city for the several objects and purposes provided in this act, upon vouchers in a form to be prescribed by the said comptroller.

4. With the consent and approval of the board of estimate and apportionment first had and obtained, the commissioners of public parks, for and in behalf of the mayor, aldermen, and commonalty of the city of New York, is hereby authorized to acquire title in fee to any land which he may deem necessary for the purpose of the construction of the said bridge and approaches, with the necessary abutments or arches as aforesaid, and to that end the said commissioners may make application to the supreme court in the first judicial district for the appointment of commissioners of estimate, specifying in such application the lands sought to be acquired for the purpose aforesaid. The provisions of law relating to the taking of private property for public streets or places in the said city are hereby made applicable, as far as may be necessary, to the acquiring of the said land as aforesaid. The amount or amounts awarded for the said land and the expense of the proceedings hereby authorized for the acquiring of the same shall form a part of and be included within the expense of constructing the said bridge and approaches thereto, with the necessary abutments and arches authorized by the third section of this act.

5. This act shall take effect immediately.

STATE OF NEW YORK,
Office of the Secretary of State, ss:

I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom and of the whole of said original law.

Given under my hand and the seal of office of the secretary of state, at the city of Albany, this ninth day of May, in the year one thousand eight hundred and ninety.

FRANK RICE,
Secretary of State.

E 6.

REMOVING OBSTRUCTIONS IN EAST RIVER AND HELL GATE, NEW YORK.

The East River is the name given to the narrow tidal strait which connects New York Harbor with Long Island Sound. It forms an entrance to the harbor of New York secondary in importance only to the main entrance by way of Sandy Hook and the Narrows, since the heavy coasting trade carried on by New York with the New England States and the British American provinces passes almost exclusively through it.

The population now gathered around the waters of New York Harbor numbers nearly 3,000,000, and should the present rate of increase, as shown by the census returns, be maintained for half a century longer, the population would then be about 8,000,000.

New York City can grow only in one direction, and that is into Westchester County, on the north, since on all other sides it is surrounded by water, and the development of the water fronts along the Hudson and the East Rivers must, therefore, be certain and rapid. With the development the importance of the East River entrance to New York Harbor will increase enormously; and within the next 50 years every foot of shore line on both sides of the East River, within 15 miles of Harlem River and Hell Gate, will be occupied with wharves filled with shipping engaged not only in the coasting and transatlantic trade, but in the commerce of the world.

The East River is crooked and narrow in places, and much obstructed by rocks, and affected by violent currents.

The worst of these obstructions is that known as Hell Gate, lying at the mouth of the Harlem River, between Blackwells and Wards Islands, about opposite Ninety-sixth street, New York. Here the river turns at

right angles around Hallets Point, divides into several channels, and runs with a velocity, varying at different stages of the tide, from 3 to 10 miles an hour over or around Hallets Point, Negro Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Holmes Rock, Hogs Back, Flood Rock, Hen and Chickens, Gridiron, the Negro Heads, Mill Rocks, Rhinelander Reef, and Bread and Cheese.

On account of the violence and irregularities of the currents and the crowded condition of this passage wrecks at Hell Gate were numerous prior to 1867. At that time some of these rocks projected above the water level, while the least depth over others at mean low water varied from nothing to 20 feet. In obedience to the provisions of the act approved June 23, 1866, an examination was made of Hell Gate by the local engineer with the view of its improvement for purposes of navigation, and three separate projects were submitted January 21, 1867, for the improvement, affording channels of 26 and 24 feet in depth at mean low water. The project which was adopted in 1867 (see Annual Report of the Chief of Engineers for 1868, page 741) provided for the removal of the rocks and reefs that lie directly in the channel to a depth of 26 feet at mean low water, and for the building of sea-walls and dikes upon others that lie near the edge of the channel, in order to guide the currents in such a way that vessels might pass the reefs in safety. The cost of the project was estimated at $8,692,645.15. The removal of Hallets Point was begun in 1869, and the final blast occurred September 24, 1876. A new estimate was made January 3, 1870, "based upon the process of tunneling the larger reefs, as Hallets Point and the Middle Reef, and removing the smaller reefs by drilling from the surface of the water," and the cost was placed at $4,689,820.

The steam-drill scow, fitted with a movable dome for submarine work, was first put in operation in the winter of 1870–'71.

The estimate was again revised in 1874 to include the removal of Diamond and Coenties Reefs (see Annual Report of the Chief of Engineers for 1874, Part II, page 164), and total cost fixed at $5,139,120. It provides for the removal, *at Hell Gate*, to a depth of 26 feet, mean low water, of the reef at Hallets Point, Ways Reef, Shell Drake, Pot Rock, Frying Pan, Heel Tap, Negro Point, and Flood Rock, including the Gridiron, Hen and Chickens, and Negro Heads, and the construction of a dike to connect the Mill Rocks, and sea walls upon Hogs Back and Holmes Rock; and, *in other parts of the East River*, for the removal of Diamond Reef and North Brothers Island Reef to a depth of 26 feet, Coenties Reef to a depth of 25½ feet, and the small rocks known as Scaly Rock, Blackwells Rock, and the rock off Woolsey's bath house.

The work of removal of Flood Rock began in June, 1875.

In 1880 the débris arising from the excavation of the galleries in Flood Rock was deposited partly in a dike to connect Great and Little Mill Rocks, and in 1882 a protection wall was built by the city authorities upon the reef at the head of Blackwells Island known as Bread and Cheese. The great blast was fired October 15, 1885.

The project was enlarged in 1884 to include the removal of Pilgrim Rock, off Nineteenth street, and again in 1889 to include the removal of the reef off Diamond Reef, reef off Thirty-third street, and Charlotte Rock, northwest of entrance to Newtown Creek, work to be done by hired labor with the drill scow.

At the close of the fiscal year ending June 30, 1890, the following parts of this project had been executed: Hallets Point, covering 3 acres; Ways Reef, Shell Drake, Diamond Reef, North Brothers Reef, Coenties Reef, and Scaly Rock had been removed to the depth contemplated in

the project; Pilgrim Rock had been reduced to a least depth of 24 feet; Heel Tap had been broken to 26 feet and dredged to 20.5 feet, and the least depths on Frying Pan and Pot Rock were 18 feet and 22.8 feet at mean low water respectively; Flood Rock and connecting reefs, covering 9 acres, had been broken to 30 feet and 132,464 tons of the débris had been removed; the Negro Heads and Hen and Chickens having been reduced to 18 feet mean low water, and a new 18-foot channel, 500 feet wide, opened across the reef. The total cost of this work was $3,814,644.84 up to June 30, 1890, including outstanding liabilities.

These results have been of the greatest value to navigation. The machinery and other plant stored at Astoria, as well as the drill scow and the vessels moored at Mill Rock, have been kept in order during the year.

The suit begun by private parties to dispossess the United States of its occupancy of the dike built by it between Great and Little Rocks was decided by the courts in May, 1889, in favor of the United States, but appeal has been taken by the complainant to a higher court. It is highly important that the United States retain possession of the dike, as the ground is very much needed for wharfage and for repair shops for the steam-drill scow and the dredges. If the United States retain possession of this dike the machinery and other plant now stored at Astoria may be taken there, and the property in store will then be relieved of some of the charges for rent and protection.

Hell Gate, as has been said, is the worst obstruction found in the East River; but there are many other rocks and reefs in other parts of this crowded water way, which are constant sources of danger to passing vessels, which have often been complained of and which ought to be removed. There is a long line of reefs and isolated rocks in mid-stream, extending a mile and a half downward from the foot of Blackwell's Island, which have always been troublesome to vessels beating up against the wind or crossing from one channel to the other, as the winds and tides often compel them to do, and which, with the continually increasing size of vessels and the increasing commerce of the river, are becoming still more dangerous.

Another obstruction is the reef lying along the New York shore between Broome street and Twenty-third street. It is 8,300 feet long and 1,100 feet wide, and prohibits by its numerous shoal points the free use of the wharves on that front by deep draft vessels. It was surveyed in August and September, 1889, to comply with the river and harbor act of August 11, 1888, and the report thereon was submitted January 24, 1890. The cost of removing the reef to a depth of 18 feet mean low water was estimated at $267,996, and to a depth of 26 feet mean low water at $4,042,718. Pilgrim Rock, which lies opposite Nineteenth street, and Sheel Reef, o pposite Tenth street, are prominent projections on this reef.

A still more serious obstruction to the navigation of the East River that is constantly complained of by mariners is Middle Ground, which is situated in mid-channel 1½ miles to the eastward of Hell Gate, near the southern entrance to Little Hell Gate, between Sunken Meadows and Lawrence Point, with a channel on either side of barely 350 feet width.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

At the opening of the fiscal year two dredges owned by the United States were at work at Flood Rock removing the stone which had been

broken up by the blast of 1885. They have been in commission throughout the year, on opposite sides of the reef, working east and west. They have not obstructed the free navigation of the river, as the channels to the northward and southward have afforded convenient passage for shipping. It is not advisable, however, to increase the plant at this point, as it is better to defer the final completion of the work than to overcrowd the channels with dredging plant.

The steam drill scow *Genl. John Newton* continued work on reef off Diamond Reef throughout the year. For the reasons stated hereafter the completion of this work has been much delayed beyond the original expectations; but it was deemed advisable not to leave the site so long as there remained any portion of the reef above the grade of 26 feet mean low water.

The river and harbor act of September 19, 1890, appropriated $200,000 for continuing this improvement. The project for the expenditure of this sum, approved by the Chief of Engineers September 27, provided that $100,000 be applied in continuing to raise broken stone from Flood Rock, Hell Gate, by use of the two United States engineer dredges, and in continuing the operations of the steam drill scow for the removal of reef off Diamond Reef, and of the remaining $100,000 to apply $50,000 to the removal of Middle Ground opposite Sunken Meadows to 18 feet mean low water, and $50,000 towards the removal of the highest projections of Shell Reef opposite Ninth street, New York City.

SHELL REEF AND MIDDLE GROUND OPPOSITE SUNKEN MEADOWS.

Proposals were invited by public advertisement to be opened November 19, 1890, for the removal of material from Shell Reef and Middle Ground opposite Sunken Meadows. The prices bid were considered too high and were rejected. A proposition was afterwards made by Mr. R. G. Packard, the lowest bidder, to do the work for 85 cents per cubic yard for material other than bowlders weighing one ton and over, and $2.50 per ton for bowlders weighing one ton and over. With the approval of the Chief of Engineers, dated November 29, 1890, a contract was entered into with Mr. R. G. Packard, dated December 19, 1890, in accordance with the terms of his new proposal. Work began under this contract May 9, 1891, on Shell Reef, with a large grapple dredge. At the close of the fiscal year 3,435½ cubic yards of material and 960½ tons of bowlders, weighing one ton and over, had been removed. The material on Shell Reef as developed by the dredge consists of sand, mud, gravel, and small stones, together with bowlders of varying size, some of which raised by the dredge weighed as much as 22 tons, while others were met with too large for the dredge to handle. Of foreign material there has been found numerous blades of propeller wheels, anchors, and a large quantity of copper sheathing that has been stripped from the bottom of vessels by the bowlders. At one place ledge rock at a depth of 18 feet mean low water has been uncovered by the operations of the dredge.

No work has yet been done on Middle Ground opposite Sunken Meadows, but it is expected that the large grapple dredge now at work on Shell Reef will be put there by August 1, or by such time as the heavy work at Shell Reef will be completed. This reef is 1,350 feet long and 480 feet wide, and has a least depth of 11¼ feet mean low water. It must not be confounded with "Middle Reef" of former estimates, which lay in Hell Gate proper. It is composed of hard sand, bowlders, and solid rock. The following table, prepared from a survey of the

reef made in June, 1890, gives the quantities of material to be removed and the estimated cost for deepening this reef to navigable depths varying from 18 feet to 26 feet mean low water, viz:

Depth.	Rock.	Estimated cost.
	Cubic yards.	
18 feet	4,950	$99,000
21 feet	22,350	447,000
26 feet	91,604	1,832,080

FLOOD ROCK.

United States engineer dredges *Flood Rock* and *Hell Gate* continued work on this reef throughout the year, as the past winter was very mild and no heavy ice was formed to compel their withdrawal. The minor repairs necessary to keep the plant in good order were made from time to time without causing any great suspension of operations.

The following shows in detail the work done during the year:

Operations.	Dredge *Flood Rock.*	Dredge *Hell Gate.*	Total.
Days worked	278	220	498
Hours worked	2,313	1,699	4,012
Surface blasts fired	169	43	212
Dynamite fired ..... pounds	12,950	2,150	15,100
Rock removed ..... tons	14,069	9,971	24,040
Raised per day ..... do	51	45	96

Total removed since explosion October 15, 1885:

By contract ..... tons	83,097	
By hired labor, using Government plant ..... do	73,407	
Total		156,504

The dredged rock has been dumped, as heretofore, in the deep hole off Eighty-ninth street, East River. This has not caused an perceptible decrease in depth, the soundings there still ranging from 80 to 120 feet mean low water.

The result of the year's work has been to reduce practically to 26 feet, mean low water, an area equivalent to one-quarter of the original reef. There still remains above low water a small portion of Flood Rock, covering an area of about 100 feet by 100 feet. No additional width has been gained for the 18-foot channel.

On September 24, 1890, a special report on this improvement was submitted to the Chief of Engineers, in which the statement is made that for the year ending June 30, 1890, the cost of removing the broken stone by the Government plant was $\$1.08\frac{3}{10}$ per ton as contrasted with the lowest bid for doing the work by contract in that year of $2.19 per ton. During the past year the cost of raising and dumping the stone by the use of the Government plant was $1.35 per ton.

REEF OFF DIAMOND REEF.

The United States steam drilling scow *Gen. John Newton*, has continued work on this reef throughout the year. Drilling was suspended in November, and thereafter the work consisted in surface blasting high points and in removing the broken rock by divers. The northwest portion of the reef was swept with the horizontal bar and cleared for a

depth of 26 feet, mean low water, on March 23. The area swept over was seven times the area of the reef as developed by the sounding rod, and the many shoal points found in this area necessitated frequent surface blasting and considerable additional labor. Since March 23 operations have continued on the southeast portion of the reef and about one-half of its area has been cleared to 26 feet. Work in the swift currents of the East River is necessarily slow, as the divers can not go down excepting at slack water, and as but two of these occur during the day, each of an average duration of about 40 minutes, but little progress can be made. The centrifugal pump which has been used for removing the sand overlying the rock and the small broken stone, has continued to fulfill all expectations. This pump is run only during the time when the currents are too strong for the divers to work under water. The following table shows in detail the work done during the fiscal year:

Number of times dome was lowered		26
Number of holes drilled		188
Total depth of holes drilled	feet	1,346
Actual time running drills	hours	125
Number of drill-hole blasts fired		27
Number of surface blasts fired		458
Pounds of explosives used. (Forcite No. 2)		29,774
Tons of broken stone raised by divers		858
Tons of broken stone raised by dredge		1,032
Tons of broken stone and sand raised by pump		847
Total tons raised and dumped during the year		2,737
Total tons raised and dumped since beginning of operations, July 8,1889		4,480

The expenses incurred on account of the improvement during the year amounted to $100,064.30, of which $8,355.91 remained outstanding at the close of the fiscal year.

The money statement shows a balance available, not covered by contracts, of $139,693.41. The ordinary repairs to the plant are necessarily heavy, and in order to provide for those and for other large expenses for repairs arising from collisions in this dangerous channel, which are liable to occur at any time of day or night, it is imperative that a reserve of not less than $40,000 should be kept on hand to maintain the plant in good working order.

The cost of running the plant, consisting of two large grapple dredges, one large steam-drill scow, and two steam tugs is $8,000, approximately, per month. The money balance will, therefore, admit of 12 months' work by the plant.

The amount that can be profitably expended in the removal of obstructions in East River and Hell Gate during the fiscal year ending June 30, 1893, is $200,000, to be applied to the removal of Flood Rock, to continuing the operations with the steam drill scow, to extending the work on Shell Reef, and to the removal of such other rocks and reefs at other points in the channel as may be shown to be obstructive to navigation.

The work is in the collection district of New York. The nearest port of entry is New York City. The nearest light-house is Blackwell Island Light. The nearest fort is Fort Columbus, Governors Island, New York Harbor.

AMOUNTS APPROPRIATED.

By acts of Congress approved—

July 25, 1868	$85,000.00
April 10, 1869	178,300.00
July 11, 1870	250,000.00
March 3, 1871	250,000.00
June 10, 1872	225,000.00
March 3, 1873	225,000.00

By acts of Congress approved—Continued.		
June 23, 1874		$225,000.00
March 3, 1875		250,000.00
August 14, 1876		250,000.00
June 18, 1878		350,000.00
March 3, 1879		250,000.00
June 14, 1880		200,000.00
March 3, 1881		200,000.00
May 4, 1882		50,000.00
By act of Congress passed August 2, 1882		200,000.00
By acts of Congress approved—		
July 5, 1884		360,000.00
August 5, 1886		112,500.00
By act passed August 11, 1888		250,000.00
By act approved September 19, 1890		200,000.00
Received from other sources		3,719.62
		4,114.519.62
Deduct amount reverted to U. S. Treasury	$3,158.55	
Deduct amount allotted to Harlem River	11,000.00	
		14,158.55
		4,100,361.07
Amount expended to June 30, 1891, inclusive or outstanding liabilities		3,905,139.09

Money statement.

July 1, 1890, balance unexpended		$95,286.28
Amount appropriated by act approved September 19, 1890		200,000.00
		295,286.28
June 30, 1891, amount expended during fiscal year		91,708.39
July 1, 1891, balance unexpended		203,577.89
July 1, 1891, outstanding liabilities	$8,355.91	
July 1, 1891, amount covered by uncompleted contracts	55,528.57	
		63,884.48
July 1, 1891, balance available		139,693.41
Amount (estimated) required for completion of existing project		1,038,840.67
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for removing obstructions in East River and Hell Gate, New York, received in response to advertisement dated October 15, 1890, and opened November 19, 1890, by First Lieut. Harry Taylor, Corps of Engineers, in the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

Material to be removed.*	1. Morris & Cummings Dredging Co.†		2. R. G. Packard.	
	Per unit.	Amount.	Per unit.	Amount.
Shell reef:				
Removing and depositing material other than bowlders (50,000 cubic yards .....cubic yard..	$0.97	$48,500.00	$0.85	$42,500.00
Removal of bowlders weighing 10 tons or less (2,000 tons)‡ .....ton..	4.80	9,600.00	3.75	7,500.00
Middle ground:				
Removal of loose bowlders (5,000 tons) .....ton..	4.80	24,000.00	3.75	18,750.00
Blasting and removing rock broken by surface blasts, ton	(§)	(§)	(§)	(§)
Removing broken rock to be blasted by the United States.....ton..	(§)	(§)	(§)	(§)
Removing and depositing material other than bowlders (1,000 cubic yards) .....cubic yard..	(§)	(§)	4.50	4,500.00
Total amount.....	.....	82,100.00	.....	73,250.00

* The quantities are assumed, and used only for comparison of bids.
† Bid informal.
‡ 2,240 pounds to the ton.
§ Omitted.

Tabular statement showing prices of R. G. Packard's proposition, dated November 21, 1890, for removing obstructions in East River and Hell Gate, New York.

Shell reef.		Middle ground.	
Removing and depositing material other than bowlders.	Removal of bowlders weighing from 1 to 10 tons, inclusive.	Removing and deposit- material other than bowlders.	Removal of bowlders weighing 1 ton and over.
Per cubic yard. $0.85	*Per ton.* $2.50	*Per cubic yard.* $0.85	*Per ton.* $2.50

RECAPITULATION.

Shell reef:		
50,000 cubic yards material other than bowlders, at 85 cents	$42,500	
2,000 tons bowlders, at $2.50	5,000	
		$47,500
Middle ground:		
1,000 cubic yards material other than bowlders, at 85 cents	850	
5,000 tons bowlders, at $2.50	12,500	
		13,350
Total		60,850

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1891, have remained practically unchanged, and therefore those reported for the year 1890 are herein repeated.

The registered tonnage, exclusive of coastwise vessels and local steamers, so far as it can be ascertained, is 10,165,325 tons.

The commerce of the East River is so intimately connected with that belonging to New York Harbor proper that it is impossible to make a separate statement for it.

The following list of vessels, not inclusive of daily passenger and freight steamers, passing through Hell Gate for the fiscal year ending June 30, 1890, has been compiled from the marine records at Whitestone, Long Island, kept by the New York Herald:

	Bound east.	Bound south.
Steamers	642	1,048
Ships	23	13
Barks	115	56
Brigs	80	61
Schooners	5,498	10,528
Tugs	680	682
Barges	2,612	2,862

E 7.

IMPROVEMENT OF NEWTOWN CREEK, NEW YORK.

Newtown Creek is a tidal stream about 4 miles long, running through the eastern part of Brooklyn, and emptying into the East River opposite Thirty-fourth street, New York. The range of tides is 4½ feet, approximately, but the bed of the creek has no natural slope.

In 1857 it had a depth of about 17 feet, which had decreased in 1880 to about 12½ feet at low water from its mouth up to the Vernon Avenue Bridge, a distance of 1,100 feet, its width for this distance being about 240 feet; thence it gradually decreased in width and depth until at the head of navigation, where the Metropolitan avenue crosses it, there was a low-water depth of about 4 feet and a width of about 100 feet.

A survey of this creek with a view to its improvement was made in 1879, by the engineer officer then in charge, to comply with the act of

March 3, 1879, and a report submitted January 31, 1880. The project provided for dredging a channel from the mouth of the creek to Vernon Avenue Bridge, 200 feet wide, and from 21 to 22 feet deep at low water, requiring the removal of 145,000 cubic yards of material, chiefly mud, the cost of which was estimated at $36,250.

Work under this project was begun in 1880, but by reason of increased cost of dredging the estimated cost was increased to $44,050.

Under the act of Congress passed August 2, 1882, another survey was made, and a report submitted December 26, 1883. (Annual Report Chief of Engineers, 1884, page 765.)

The new project provided for carrying the improvement from the Vernon Avenue Bridge up to the head of navigation in both branches of the creek. The estimated cost of executing this project was as follows:

To excavate a channel 18 feet deep and 175 feet wide from Vernon Avenue Bridge to the Central Oil Works, 143,500 cubic yards excavation, at 30 cents	$43,050
Thence 15 feet deep and from 125 to 150 feet wide to Queens County Oil Works, 101,600 cubic yards of excavation, at 35 cents per cubic yard	35,560
Thence 12 feet deep and 125 to 150 feet wide to Nichols Chemical Works, 52,600 cubic yards excavation, at 40 cents per cubic yard	21,040
Thence 10 feet deep and from 100 to 125 feet wide to the head of navigation on both branches, 231,600 cubic yards excavation, at 40 cents per cubic yard	92,640
Contingencies	19,229
To which must be added the revised estimate for work below Vernon Avenue Bridge, before given	44,050
Total estimated cost of improving Newtown Creek	255,569

The appropriations of 1884 and 1886 were applied in deepening the channel from the entrance to Vernon Avenue Bridge to 18 feet deep, mean low water, and from Maspeth avenue eastward to the head of navigation 10 feet, mean low water. The amount appropriated up to and inclusive of act of August 5, 1886, was $82,500, of which amount the sum of $50,750 has been applied from Vernon Avenue Bridge to the East River and $31,750 from Covert Dock, upstream to the head of navigation on both branches. These appropriations were made in small amounts and at wide intervals, and the work done by them gave only temporary relief. According to these methods the amounts applicable for improvement at the entrance were about sufficient to remove deposits which had been made during the interval, leaving no balance for increasing the depth beyond 20 feet. The improvement could not, for want of funds, be extended to benefit the central reach of the river above Vernon Avenue Bridge, and, in the absence of secure bulkheads, dredging in the upper branches was of little avail. It would have been better had appropriations been made in such a way that the improvement above Vernon Avenue Bridge could have been executed as an extension of the improvement below it. Then as the improvement advanced upstream the wharves along the banks would have been benefited progressively and in proportion to their importance.

A revised estimate for the improvement was made in 1889 (Annual Report Chief of Engineers, 1889, Part I, page 778), after the results obtained by the survey of January, 1889, had been studied, and the cost was fixed at $170,586.

In preparing the new project for the improvement it was kept in mind that the draft of vessels going above Vernon Avenue Bridge, where the most important wharves are located, was limited by the then available depth of water, and that many of the vessels had to be lightered

at the bar to facilitate entrance at high tide, while those going out had to complete their cargoes after they reached the East River. It was therefore thought best to provide for 21 feet from the entrance to Vernon Avenue Bridge, 18 feet to Central Oil Works, 15 feet to Queens County Oil Works, 12 feet to Nichols's Chemical Works, and 10 feet to Metropolitan Avenue Bridge on both branches.

The bed of the creek below Vernon Avenue Bridge is variable in character below the plane of 18 feet mean low water. Near the bar it is composed of sand or sand and clay mixed; but as the bridge is approached it grows harder, like hardpan, and has large bowlders embedded in it. The creek is the receptacle for all the refuse from the sewers, factories, slaughter-houses, and oil refineries of the east of Brooklyn. Constant deposits are therefore forming in it, especially at the upper end, from these causes and from the caving in of the unprotected banks, which consist of marsh mud. To remedy this difficulty annual dredging will be needed until the banks are protected by bulkheads throughout their whole length.

The appropriation of 1888 was applied in deepening the channel from entrance to Vernon Avenue Bridge to 21 feet mean low water; to Central Oil Works, 18 feet, and to Queens County Oil Works, 10 feet.

The river and harbor act of September 19, 1890, appropriated $35,000 for continuing the improvement.

The following table shows the location and characteristics of the several bridges crossing Newtown Creek:

Name and location of bridge.	Width of draw.	Height of bottom chord above mean high water.	Remarks.
	Feet.	*Feet.*	
Vernon Avenue Bridge.....	63	7.3	Road bridge; double draw; iron on wooden pier; opens by hand power.
Blissville Bridge (Greenpoint avenue).	58	8.9	Road bridge; double draw; wood on wooden pier; opens by hand power.
Penny Bridge (Meeker avenue.)	53	9.7	Road bridge; double draw; iron on stone pier; opens by hand power.
Grand Street Bridge.....	57	5.8	Iron on stone pier; single draw; road bridge; opens by hand power.
Metropolitan Avenue Bridge (Metropolitan Avenue and Grand Street Junction).	62	8.7	Road bridge; double draw; iron on stone pier; opens by hand power.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

At the opening of the fiscal year the agreement with Mr. James A. Simmons, by authority of the Secretary of War, dated February 11, 1889, was still in force and operations were continued until September 6, 1890, when the contract was completed.

The quantity of material removed under this agreement during the fiscal year was 24,104 cubic yards and the total amount removed was 115,692 cubic yards.

The results obtained were a channel 100 feet wide and 21 feet deep, mean low water, from the entrance to Vernon Avenue Bridge; a channel 80 feet wide and 18 feet deep, mean low water, from Vernon Avenue Bridge to Central Oil Works, and the removal of the shoal opposite the Queens County Oil Works to a depth of 10 feet, mean low water.

The river and harbor act of September 19, 1890, appropriated $35,000 for continuing the improvement, one-fourth to be expended on the main

branch between Maspeth and Metropolitan avenues and one-fourth on the English Kills branch.

The project for the expenditure of this appropriation, approved by the Chief of Engineers September 27, 1890, proposed to continue the approved project by opening the 15-foot channel from Central Oil Works to Queens County Oil Works, and the 12-foot channel from Queens County Oil Works to Penny Bridge; in opening a channel 100 feet wide and 10 feet deep from Maspeth Avenue to Metropolitan Avenue, and in opening a channel 100 feet wide and 10 feet deep in English Kills branch.

Advertisements and specifications were issued October 15, 1890, inviting proposals to be opened November 21, 1890. The bids received were all considered too high and were accordingly rejected. A modified bid with lower prices was received from the Atlantic Dredging Company, which, being considered reasonable and just, was recommended for acceptance and received approval of the Chief of Engineers December 8, 1890; a contract was accordingly entered into with that company under date of January 17, 1891.

Work began under this contract, with 2 dipper dredges below Vernon Avenue Bridge, January 28, and continued until February 18, when the removal of 14,400 cubic yards of material allotted to this part of the creek was completed. Operations began February 5 on the main branch between Maspeth and Metropolitan Avenues and were completed April 11, at which date 28,839 cubic yards had been removed. Work began on English Kills branch April 10, and was completed May 12, when 28,988 cubic yards had been removed. On May 13, work was begun below Penny Bridge, and at the close of the fiscal year 25,577 cubic yards had been dredged.

A large bowlder lying in the channel at the entrance to Newtown Creek, uncovered by the operations of the dredge, was removed by hired labor March 24, 1891, under authority of the Chief of Engineers dated March 16, 1891.

At the close of the fiscal year the channel from the entrance to Vernon Avenue Bridge is 175 feet wide at the entrance and 150 feet wide near the bridge, and is 21 feet deep, mean low water. The channel from Vernon Avenue Bridge to Central Oil Works is 80 feet wide and 18 feet deep; from Central Oil Works to Queens County Oil Works, 50 feet wide and 15 feet deep; from Queens County Oil Works to Penny Bridge, 50 feet wide and 12 feet deep. The channel from Maspeth Avenue to Metropolitan Avenue is 100 feet wide and 10 feet deep, mean low water. In the English Kills branch the channel is 100 feet wide and 10 feet deep from Nichols's Chemical Works to a point 700 feet to the eastward.

An appropriation of $75,000 is recommended for continuing the improvement.

This work is in the collection district of New York. Nearest port of entry, New York City. Nearest light-house, Blackwells Island. Nearest fort, Fort Columbus.

Amounts appropriated.

Application.	Date.	Amount.
Dredging below Vernon Avenue Bridge	June 14, 1880	$10,000
Do	Aug. 2, 1882	15,000
Part applied above Vernon Avenue Bridge	July 5, 1884	20,000
Below and above Vernon Avenue Bridge	Aug. 5, 1886	37,500
Newtown Creek and Bay	Aug. 11, 1888	25,000
Do	Sept. 19, 1890	35,000
Total		142,500

Amount expended to June 30, 1891, inclusive of outstanding liabilities, $136,026.07.

Money statement.

July 1, 1890, balance unexpended		$7,272.98
Amount appropriated by act approved September 19, 1890		35,000.00
		42,272.98
June 30, 1891, amount expended during fiscal year		28,667.04
July 1, 1891, balance unexpended		13,605.94
July 1, 1891, outstanding liabilities	$7,132.01	
July 1, 1891, amount covered by uncompleted contracts	4,094.96	
		11,226.97
July 1, 1891, balance available		2,378.97
Amount (estimated) required for completion of existing project		113,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		75,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1886 and 1867.		

Abstract of proposals for improving Newtown Creek, New York, received in response to advertisement dated October 15, 1890, and opened November 21, 1890, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

Number.	Names of bidders.	From East River to Vernon Avenue Bridge. Available, $5,800.		From Central Oil Works to Queens County Oil Works. Available, $7,500.		From Queens County Oil Works to Penny Bridge. Available, $3,125.		From Maspeth avenue to Metropolitan avenue Bridge. Available, $7,500.		English Kills (west branch). Available, $7,500.	
		Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.
			Cu.yds.		*Cu.yds.*		*Cu.yds.*		*Cu.yds.*		*Cu.yds.*
1	Atlantic Dredging Company	*$0.47	12,340	*$0.30	25,000	*$0.30	10,417	*$0.29	25,862	*$0.29	25,862
2	W. H. Beard	------	------	------	------	------	------	------	------	------	------
3	Thomas Potter	------	------	------	------	------	------	.26	28,846	.26	28,846
4	Morris & Cumings Dredging Company	.49	11,836	.33	22,727	.33	9,470	.32	23,438	.36	20,833

*Lowest bid.

Total amount available for the work, $31,425.

Tabular statement showing revised proposal of the Atlantic Dredging Company for dredging in Newtown Creek, New York.

No.	Name of bidder.	From mouth to Vernon Avenue Bridge. Available, $5,800.		Above Vernon Avenue Bridge. Available, $25,625.	
		Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.
			Cubic yards.		*Cubic yards.*
1	Atlantic Dredging Company	$0.40	14,500	$0.26	98,557

Total amount available for the work, $31,425.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1891, have remained practically unchanged, and therefore those reported for the year 1890 are herein repeated.

Imports and exports.

Articles.		Amount.		Value.
		Imported.	Exported.	
Lumber	feet B. M.	263,040,852	21,000,000	$5,936,994
Coal	tons	440,410	.....	1,652,794
Oil	cases	.....	2,937,273	2,900,000
	gallons	19.949,255	29,252,557	3,026,509
Residuum	do	20,093,200	1,378,148	623,438
Grain	bushels	140,000	.....	140,000
Brick		125,000,000	.....	650,000
Lime and cement	barrels	260,000	.....	260,000
Stone and sand	tons	105,000	.....	107,000
Chalk	do	20,000	.....	70,000
Tin, lead, iron, and steel	do	9,776	500	905,791
Oil of vitriol	pounds	20,457,437	.....	135,840
Jute, hemp, manilla, etc	tons	200,000	.....	2,000,000
Empty barrels and cases		577,058	1,036	460,033
Naphtha	gallons	.....	6,464,226	381,983
Candles and wax	pounds	.....	11,765,064	539,506
Separated acid	gallons	.....	1,035,695	19,366
Miscellaneous	tons	.....	24,075	2,236,521
Total		.....	.....	22,045,745

Vessels arriving and departing.

Class.	Number.	Tonnage.
Steamers	12	15,240
Ships	26	31,200
Barks	125	87,500
Brigs	13	10,400
Schooners	2,226	1,113,000
Lighters	1,022	204,400
Barges	2,782	556,400
Canal boats	3,068	306,800
	9,274	2,324,940

There were built on Newtown Creek 23 new vessels, 7,200 tons capacity, and valued at $265,000.

E 8.

IMPROVEMENT OF BUTTERMILK CHANNEL, NEW YORK HARBOR.

Buttermilk Channel is the name given to the channel which separates Governors Island, at the mouth of the East River, New York Harbor, from the city of Brooklyn, which lies east of it.

The channel on the northwest side of Governors Island, which separates it from the lower end of the city of New York, is the wider and deeper of the two, and is the channel most used by vessels passing between the East River and other parts of New York Harbor.

Buttermilk Channel is obstructed by three shoals:

1. A shoal lying above and northeast of Governors Island, projecting into Buttermilk Channel, and extending over to the main channel on the other side, which originally had a least depth over it of $9\frac{1}{2}$ feet at mean low water.

2. A shoal putting out from Red Hook Point, on the Brooklyn side, and extending up to the eastern side of the channel to the entrance of the Atlantic Basin, with a least depth on it of about 5 feet at mean low water.

3. A shoal putting out from the southern side of Governors Island and extending towards the Red Hook Point Shoal, which is partly dry at mean low water.

Between the first-mentioned shoal and Governors Island there was formerly a narrow channel with 30 feet of water in it, and between this shoal and the Brooklyn shore a channel of the same depth, also originally narrow.

A narrow and crooked channel about 30 feet deep lies between the two latter shoals.

The line of docks and wharves from the Brooklyn Bridge down to the mouth of the Atlantic Basin on the Brooklyn side is one of the most important in the New York Harbor, and this part of the river, extending from the Brooklyn Bridge to Governors Island, is regarded by pilots and masters of vessels as one of the most difficult places in New York waters to carry a vessel through safely on account of this shoal, the rapid current, and the enormous traffic passing not only up and down but across the stream.

Tows, tugs, small steamers, and small craft generally in passing up and down this part of the East River keep to the New York side, forcing the larger class of sound steamers, ocean steamers, and seagoing ships in tow of tugs to keep over towards the shoal at the upper point of Governors Island, and if, as is often the case, these vessels are obliged to stop in order to avoid collision with ferryboats, sloops, and canal-boat tows they are liable to drift upon this shoal.

Upon a statement of these difficulties, made by shipping merchants and others whose business lay along the Brooklyn wharves between Wall Street Ferry and the Atlantic Basin, a survey of this shoal was ordered in 1872 and a project for its improvement was adopted in 1880.

The appropriations made by the several river and harbor acts from June 4, 1880, to August 11, 1888, both inclusive, have been applied towards the complete removal of this shoal to a depth of 26 feet mean low water at an estimated cost of $346,000.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

At the opening of the fiscal year a contract was in force with Mr. James A. Simmons, of New York, for the removal of 500,000 cubic yards of material from the shoal. This quantity, it was believed, was ample to provide against all contingencies of illicit dumpings and shoalings from natural causes to which the locality is subject, and to give a full depth of 26 feet mean low water everywhere over the shoal. Of this quantity 206,199 cubic yards had been removed prior to June 30, 1890, by which the southern end of the shoal had been lowered to the plane of 26 feet mean low water, and a north and south cut 450 feet wide had been excavated along the whole of the shoal.

The dredge was withdrawn from the work December 3 and placed upon the contract for Gowanus Bay improvement, pending a resurvey of the Buttermilk Shoal to determine whether any further work was necessary there. Work was resumed on this shoal April 20, and has continued there uninterruptedly to the close of the year.

The contract is still in progress, and the shoal has been removed to the plane of 26 feet, mean low water, except over a few points where the depth is slightly less. It is expected that the shoal will be entirely removed to the required depth by July 4.

The quantity of material removed under the contract to date is 395,739 cubic yards. The contract calls for the removal of 500,000 cubic yards from the shoal, but the operations under the contract show that the shoal will not provide more than 400,000 cubic yards above the 26-foot curve.

On the extension of the contract, March 31, 1890, the contractor was given the privilege of excavating the full contract quantity by removing part of the shoal at Red Hook Point, near Atlantic Basin, but, owing to the legal embarrassments under which the contractor now labors, which prevent him from giving the work his personal attention, notice has been given in writing by his attorney that the option will not be accepted, and that he will ask to have his contract closed on the completion of the work projected at the original shoal.

The river and harbor act of September 19, 1890, provided for a survey of "Buttermilk Channel and Gowanus Bay Channels in New York Harbor, with a view of straightening the same by removing the shoals opposite the southeast side of Governors Island, protecting the channels by a sea wall on Governors Island, and to provide for the full width thereof a uniform depth of 26 feet at mean low water throughout these channels along the wharves of Brooklyn, from a point opposite Wall Street Ferry to the foot of Bryant street, Brooklyn."

A report was submitted to the Chief of Engineers upon the survey October 17, 1890 (House Ex. Doc. No. 26, Fifty-first Congress, second session), in which it is stated that the "shoals opposite the southeast side of Governor Island" (Red Hook Shoal) contain 1,484,048 cubic yards of material, measured in place, and should be removed to the depth of 26 feet, mean low water, but that no sea wall on Governor Island would be needed to maintain the improved channel.

The recommendation for the removal of Red Hook Shoal is here repeated; when this work is done Buttermilk Channel, opposite Atlantic Basin, will be 1,000 feet wide, and the set of the currents will be so direct along the southern margin of Governors Island that the improved depths will be maintained with reasonable certainty, without the necessity for an artificial bank to be built upon that island or upon the shoal extending from it to the southwestward.

An appropriation of $200,000 is recommended towards the completion of this improvement, which is required to facilitate the navigation of the southern entrance to Buttermilk Channel, off Red Hook Point, now obstructed by a shoal reef.

This work is in the collection district of New York. The nearest port of entry is New York City, and the nearest work of defense, Fort Columbus, New York Harbor. The nearest light-house is Robbins Reef.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	June 4, 1880	$60,000
Do	Mar. 3, 1881	60,000
Do	Aug. 2, 1882	60,000
Do	July 5, 1884	10,000
Do	Aug. 5, 1886	56,250
Do	Aug. 11, 1888	100,000
Total	.....	346,250
Received from other sources	.....	100
		346,350

Amount expended to June 30, 1891, inclusive of outstanding liabilities, $321,926.56.

Money statement.

July 1, 1890, balance unexpended		$73.370.04
June 30, 1891, amount expended during fiscal year		36,474.81
July 1, 1891, balance unexpended		36,895.23
July 1, 1891, outstanding liabilities	$12,471.79	
July 1, 1891, amount covered by uncompleted contracts	19,288.24	
		31,760.03
July 1, 1891, balance available		5,135.20
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1891, have remained practically unchanged, and, therefore, those reported for the year 1890 are herein repeated.

The commerce of Buttermilk Channel is so intimately connected with that of New York Harbor that it is impracticable to determine the amount and value.

The number and tonnage of vessels loading and unloading at the Brooklyn wharves, immediately fronting on Buttermilk Channel, during the fiscal year ending June 30, 1890, as shown by the Maritime Register, is as follows:

Vessels arriving and departing.

Class.	Number.	Tonnage.
Steamers	1,047	1,430,192
Ships	253	389,996
Barks	1,632	783,360
Brigs	312	99,600
Schooners	714	214,200
Total	3,958	2,917,348

This does not include the numerous lighters and canal boats, of which no record is kept.

E 9.

IMPROVEMENT OF GOWANUS BAY, NEW YORK.

Gowanus Bay is a part of New York Harbor, lying at the mouth of Gowanus Creek, in the southeastern part of the city of Brooklyn. The depth of water in the channel was formerly 7 to 12 feet at mean low water, which was wholly insufficient for the passage of the vessels employed in the commerce of the district. A survey of Gowanus Bay and Creek was made in 1880, and a project for their improvement was submitted in January, 1881.

This project provided for dredging a channel between the pier lines established by the commissioners appointed by the State of New York in 1875, beginning at the bay and extending up the creek to Hamilton Avenue Bridge, 18 feet deep at mean low water and 200 feet wide, except for the upper few hundred feet near the bridge, where the width was to be gradually reduced from 200 feet to 100 feet.

The total length of the proposed channel was about 9,000 feet.

The estimated cost of this improvement was as follows:

530,000 cubic yards of dredging, at 30 cents per cubic yard	$159,000
Contingencies	23,850
Total	182,850

The proposed channel, however, did not follow the old channel at the mouth of the creek, since the pier line established by the State commission of 1865 crossed the old channel at that point and encroached upon the water grant of the riparian owners.

The owners of this property, Messrs. Beard & Robinson, were anxious, nevertheless, to have the old channel improved instead of having the new one formed, as proposed, outside of the established pier line; but, as this could not be done, they surrendered their right to build out to the pier line; they signed a paper relinquishing their right to build piers which should obstruct the old channel so long as that channel should be permitted to exist; and the Maritime Association of New York at the same time petitioned that the old channel should be kept open. As the improvement of this channel would, however, help only the land near it on the north side, and not at all that which lay on the opposite or southerly side of the creek, the local officer recommended that the conflict of interest be settled by dredging the natural channel from the Hamilton Avenue Bridge down to the southwest corner of the Erie Basin; and that from that point two channels be dredged, one running northerly along the west side of the Erie Basin to deep water near Red Hook, and the other running southerly along the wharves on the south side of the bay towards Bay Ridge.

Both of these channels were to be 200 feet wide and 18 feet deep at mean low water.

This project required for its execution a larger amount of work than the original scheme called for, namely:

The excavation of 583,530 cubic yards of material, which, at 30 cents per cubic yard, would cost	$175,059.00
Contingencies, 10 per cent.	17,505.90
Total	192,564.90

The legal measures necessary for securing the right of way across Beard & Robinson's property, at the mouth of the creek, were completed satisfactorily by May, 1883, and under appropriations of 1881, 1882, and 1883 the proposed Red Hook branch of the channel was dredged 100 feet wide for a length of 2,000 feet, measured from Red Hook, and the Southern Channel, running towards Bay Ridge, was begun at the southern end and carried northward for a distance of 1,900 feet, with depths in it varying from 21 to 17 feet, except for a few hundred feet at the upper end on the eastern side, where the last cut was left unfinished.

The sum of $7,500 was appropriated by the act of August 5, 1886, and was applied towards the improvement of the Red Hook and Gowanus Creek Channel, which at the close of the contract for dredging, March 12, 1887, was 200 feet wide and 18 feet deep from the entrance to the foot of Court street, Brooklyn, and thence 40 feet wide and 15 feet deep to Sigourney street.

A sketch of the work, June 30, 1885, may be found in the Annual Report Chief of Engineers for that year, Part I, page 672.

Under the estimates of $192,564.90 only $72,500 had been appropriated to June 30, 1887.

In the Annual Report for 1888, page 615, the local officer states that

the dimensions previously adopted for the two channels are too small, in view of the great increase in length and draft which had taken place lately in the construction of sea-going vessels, especially steamers, and recommended that the depth of these channels should be increased to 21 feet mean low water, and their width to 400 feet, while to facilitate the handling of vessels in the contracted space near the mouth of Gowanus Creek more room should be gained by cutting away the angle on the south side.

It was estimated that to make these changes in the channel would involve the removal of 1,345,000 cubic yards of material measured in place, as follows:

Red Hook Channel (from entrance to Henry street):		
To deepen it to 21 feet	cubic yards..	70,000
To widen it to 400 feet	do....	100,000
		170,000
Gowanus Creek Channel (from Henry street to Hamilton Avenue Bridge):		
To deepen it to 21 feet	cubic yards..	350,000
To cut away at the angle	do....	300,000
		650,000
Bay Ridge Channel (from Twenty-eighth street to Sixtieth street, South Brooklyn):		
To deepen it to 21 feet	cubic yards..	250,000
To widen it to 400 feet	do....	275,000
		525,000
Total in place	cubic yards..	1,345,000
Which, at 40 cents per cubic yard, would cost		$538,000
Contingencies		62,000
Total		600,000

The river and harbor act of August 11, 1888, making appropriation for continuing the improvement, reads as follows:

> Continuing the improvement by dredging to 21 feet mean low water and widening the channel to 400 feet on the northerly side from the foot of Percival street along the wharves to the 23-foot curve opposite the entrance to Erie Basin, $60,000.

This provided for the commencement of the first and second parts of the project recommended in 1888. The required width of 400 feet at the entrance could not be obtained without dredging inside the pier and bulkhead line established by the State in 1875, and in the upper 3,000 feet of the creek could not be made 400 feet wide without interfering with the vested rights of property on the west side to such a degree as to practically prohibit the execution of the project. The project which was accordingly adopted for the application of the appropriation provided that the channel to be ultimately dredged should be 400 feet wide from the entrance to the eastern end of the Erie Basin, and carried thence 250 feet wide to the foot of Percival street, where provision would be made again for widening the channel by dredging out the three triangular spaces or slips on the north side immediately below that street.

A contract was made with Mr. James A. Simmons February 27, 1889, for the removal of 300,000 cubic yards of material from Red Hook and Gowanus Creek Channel, extending from the entrance near the western entrance to Erie Basin to Percival street, and at the close of the last fiscal year 174,905 cubic yards of material had been removed, giving a channel 75 feet wide and 19 to 21 feet deep to the foot of Percival street.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

1. *General improvement: Red Hook and Gowanus Creek Channel.*—Operations under the contract dated February 27, 1889, were completed February 26, 1891, at which time 298,407 cubic yards of material had been removed. The result of the work under this contract has been to deepen the channel to 21 feet mean low water for a width of 100 feet from the entrance to Erie Basin to the foot of Percival street, including the triangular slips at the foot of Court, Bryant, and Smith streets.

The river and harbor act approved September 19, 1890, provided for the survey of Buttermilk and Gowanus Bay Channels with the view of giving them "a uniform depth of 26 feet at mean low water throughout these channels along the wharves of Brooklyn from a point opposite Wall Street Ferry to the foot of Bryant street, Brooklyn."

A report was submitted to the Chief of Engineers upon the survey October 17, 1890 (House Ex. Doc. No. 26, Fifty-first Congress, second session), in which it was stated that the existing project which provides for an improved depth of 21 feet mean low water will on completion, be adequate to the present needs of Gowanus Bay, and that the enlargement of the project so as to give 26 feet depth mean low water is unnecessary at this time.

The river and harbor act of September 19, 1890, appropriated $60,000 for improving channel at Gowanus Bay, New York, to be applied on the northerly side from the foot of Percival street along the wharves to the 23-foot curve opposite the entrance to the Erie Basin.

After advertisement of the work according to law, a contract was made on January 8, 1891, with Mr. W. H. Beard for the removal of 260,000 cubic yards material, at 21 cents per cubic yard. Operations began under the contract March 20 with two large dipper dredges, starting at the entrance, near the western entrance to Erie Basin, and working southward and eastward towards Percival street. The quantity removed to the close of the fiscal year was 105,114 cubic yards, and the channel was then 150 feet wide and 21 feet deep mean low water from the entrance to Erie Basin to Twenty-eighth street, thence to the foot of Percival street 100 feet wide and 21 feet deep, and the triangular slips at the foot of Court, Bryant, and Smith streets had been dredged to 21 feet.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $52,216.37.

2. *Bay Ridge Channel.*—This channel is situated on the south side of Gowanus Bay, and extends from Twenty-eighth street, South Brooklyn, southward and westward, to Bay Ridge, at Sixtieth street. The project for the improvement of Gowanus Bay, based on the survey of 1880, provided for a channel on the north side of the bay from the entrance to Hamilton Avenue Bridge. While this project was pending a conflict arose between the riparian owners on the two shores in regard to the application of the money, those on the south shore alleging that their interests were ignored. A compromise was effected, and the project was revised to include the improvement of the channel along the south shore, known as the Bay Ridge Channel.

From allotments made from appropriations of 1881 and 1882 work began under the revised project in 1883, and when the contract was closed, January 21, 1884, the Bay Ridge Channel had been deepened to 18 feet, mean low water, over a width of nearly 200 feet, from Forty-eighth street, South Brooklyn, northward, to opposite Fortieth street.

Work, which was then suspended, was not resumed until May 13, 1891, at which time a contract, formed under the river and harbor act of September 19, 1890, which appropriated $100,000 specifically for the Bay Ridge Channel improvement, was begun. The act reads as follows:

> Improving Bay Ridge Channel in Gowanus Bay, New York Harbor, by dredging out and opening the same from a point at its junction with the Gowanus Creek Channel (near Twenty-eighth street), southerly therefrom along and in front of Gowanus Bay and Bay Ridge to a point where the said Bay Ridge Channel so to be opened encounters a twenty-one foot contour or depth of water, so that a channel so to be opened shall be of a uniform depth of twenty-one feet and a width of four hundred feet at low water, one hundred thousand dollars.

It will be observed that the act provides for an improved channel which shall be 400 feet wide and 21 feet deep, mean low water.

The work was advertised according to law, and a contract was made January 8, 1891, with Mr. W. H. Beard for the removal of 450,000 cubic yards of material, at 21 cents per cubic yard.

The improvement begins at Twenty-eighth street and will be carried southward 200 feet wide and 21 feet deep, mean low water, to opposite Sixtieth street. The money available is just sufficient to complete one-half the project contained in the act, subject to such deterioration as may arise from material sliding into the improved channel from the south bank.

The contractor began operations May 12 with a large clamshell dredge at Forty-second street, working southward towards Sixtieth street; May 18 with one large dipper-dredge, and on June 1st with a second dipper-dredge at Forty-second street, working towards Twenty-eighth street; and up to the close of the fiscal year the combined plant had removed 84,815 cubic yards of material. The improvement had then been carried north of Forty-second street, a distance of 1,800 feet, 30 feet wide and 21 feet deep, and south a distance of 650 feet, 35 feet wide and 21 feet deep.

The amount expended during the fiscal year ending June 30, 1891, inclusive of outstanding liabilities, was $18,450.15.

The river and harbor act approved September 19, 1890, provided for a survey of "Bay Ridge Channel (New York), with a view of removing the shoal and providing a uniform depth of 23 feet at mean low water opposite the Bay Ridge shore to the 23-foot curve in the New York Harbor."

No special survey was made to comply with the requirements of the act, as a detailed survey over the entire area considered, except the shoal, had been made in July, 1890, which furnished all the needed data for making the required estimates.

A report was submitted to the Chief of Engineers upon the survey of October 17, 1890 (House Ex. Doc. No. 60, Fifty-first Congress, second session), in which it is stated that if the project authorized by the river and harbor act of September 19, 1890, already quoted in this report, which contemplates a channel 400 feet wide and 21 feet deep, mean low water, along the Bay Ridge shore, be enlarged so as to increase the depth in said channel to 23 feet, mean low water, the additional material required to be removed was estimated at 294,907 cubic yards, scow measurement, allowing one-half foot overdepth and 30 per cent. increase of bulk. It was also stated that the "shoal" mentioned in the act lies immediately westward of the Bay Ridge shore, from which it is separated by the Bay Ridge Channel, is 3 miles long, approximately, has an average width of 3,600 feet between 23-foot curves, and contains 10,171,491 cubic yards of material between said curves, measured in scows.

The removal of the "shoal" was not recommended for the reason that it gives the wharves on the south side of the bay a certain degree of protection against high seas resulting from westerly and northwesterly storms, and if removed would doubtless have to be replaced by an expensive artificial breakwater; and the deepening of the channel to 23 feet at mean low water was not recommended for the reason that every reasonable facility will be given to the commerce of the bay by the navigable depth of 21 feet, mean low water, which the existing project affords.

In regard to the harbor lines for the south shore of Gowanus Bay (along the Bay Ridge Channel), adopted by the Secretary of War March 4, 1890, attention is invited to the fact that "the piers between the adopted pier and bulkhead lines may be filled with solid material when an equal tidal prism is provided in compensation therefor behind the authorized bulkhead lines and adjacent to said piers." (Annual Report Chief of Engineers, 1890, page 815).

The amount that can be profitably expended upon the improvement of Gowanus Bay Channels during the fiscal year ending June 30, 1893, is $200,000, which amount should be appropriated in one sum for distribution, by allotment, between the Red Hook and Gowanus Creek and Bay Ridge Channels, at the discretion of the Secretary of War.

Gowanus Bay is in the collection district of New York City. Nearest light, Robbin Reef. Nearest work of defense, the fort on Governors Island, 1 mile to the northward.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	Mar. 3, 1881	$40,000
Do	Aug. 2, 1882	20,000
Do	July 5, 1884	5,000
Do	Aug. 5, 1886	7,500
Do	Aug. 11, 1888	60,000
Do	Sept. 19, 1890	160,000
Total		292,500

Amount expended to June 3, 1891, inclusive of outstanding liabilities, $173,455.11.

Money statement.

July 1, 1890, balance unexpended		$29,711.41
Amount appropriate by act approved September 19, 1890		160,000.00
		189,711.41
June 30, 1891, amount expended during fiscal year		53,653.31
July 1, 1891, balance unexpended		136,058.10
July 1, 1891, outstanding liabilities	$17,013.21	
July 1, 1891, amount covered by uncompleted contracts	109,529.19	
		126,542.40
July 1, 1891, balance available		9,515.70
Amount (estimated) required for completion of existing project		480,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		200,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for improving Gowanus Bay, New York, received in response to advertisement dated October 15, 1890, and opened November 21, 1890, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	From entrance to Erie Basin to foot of Percival street. Available, $55,000.		Bay Ridge Channel, from 28th to 60th streets. Available, $95,000.	
		Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.
			Cubic yards.		*Cubic yards.*
1	Atlantic Dredging Company	$0.21 9/10	251,141	$0.21 9/10	433,790
2	W. H. Beard	*.21 3/4	252,873	*.21 3/4	436,781
3	Thomas Potter	------	------	------	------
4	Morris & Cumings Dredging Company	.23	239,130	.23	413,043

* Lowest bid.

Total amount available for the work, $150,000.

Tabular statement showing revised proposals of the Atlantic Dredging Company and W. H. Beard for dredging in Gowanus Bay, New York.

No.	Name of bidder.	From entrance to Erie Basin to foot of Percival street. Available, $55,000.		Bay Ridge Channel from Twenty-eighth to Sixtieth streets. Available, $95,000.	
		Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.
			Cubic yards.		*Cubic yards.*
1	Atlantic Dredging Company	$0.21 1/2	255,814	$0.21 1/2	441,860
2	W. H. Beard	*.21	261,905	*.21	452,381

* Lowest.

Total amount available for the work, $150,000.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1891, have remained practically unchanged, and therefore those reported for the year 1890 are herein repeated.

[For the year ending December 31, 1889.]

Receipts and shipments.

Articles.	Quantity.	Value.
Coal ..... tons	687,000	$2,748,000
Brick ..... number	202,000,000	1,414,000
Lumber ..... feet, B. M.	147,000,000	2,940,000
Lime, etc ..... barrels	460,000	690,000
Grain ..... bushels	2,750,000	1,100,000
Ice ..... tons	230,000	805,000
Roofing tar ..... barrels	75,000	225,000
Building stone, etc	.....	647,000
Miscellaneous	.....	2,500,000
Total	.....	13,069,000

Vessels arriving and departing below Hamilton Avenue Bridge.

Class.	Number.	Tonnage.
Steamers	46	33,211
Ships	68	105,741
Barks	439	441,614
Brigs	56	17,627
Schooners	281	57,392
Total	890	655,585

Vessels arriving and departing above Hamilton Avenue Bridge (record of bridge tender).

	Times opened and closed.	Vessels passed through.	Registered tonnage.	Daily average of times opened.
June 1, 1889, to May 31, 1890	8,624	7,668	1,430,664	28
1886	7,632	6,071	985,431	21
Increase	992	1,597	445,233	7

Classification of vessels.

	Number.	Registered tonnage.	Draft.
			Feet.
Schooners	1,393	172,738	6–12
Sloops	972	62,925	6–10
Barges	1,625	409,486	6– 8
Canal boats	3,678	785,515	6– 8
Total	7,668	1,430,664	.....

The increase in value of receipts and shipments compared with 1887 is $749,000. It is believed that the values as stated in 1887 are too large, and that the true increase is very much larger.

BAY RIDGE CHANNEL.

These statistics have been compiled this year and are not included in the previous table:

Material.	Tons.	Value.
Asbestos roofing paint	40,000	1,250,000
Petroleum and its products	.....	3,000,000
Acids and chemicals	15,000	235,000
Phosphates	20,000	340,000
Steel sugar wagons	8,000	150,000
		4,975,000

There are large factories and piers building along the line of the channel, which will enhance the tonnage and values.

No estimate could be got of the number of small vessels supplying the various establishments.

E 10.

IMPROVEMENT OF NEW YORK HARBOR, NEW YORK.

New York Harbor is the name applied to the waters surrounding the city of New York, comprising parts of the Hudson, East, and Harlem Rivers, and the upper and lower bays lying respectively inside and outside of the Narrows, and between the Long Island, Staten Island, and New Jersey shore.

The city of New York, from which the harbor takes its name, lies at the mouth of the Hudson River at its junction with the East River; and, with the adjacent cities of Brooklyn and Jersey City, which are but the natural outgrowths of New York energy and enterprise, includes a population of nearly 3,000,000 inhabitants, which is more than the population of any State in the Union, excepting New York, Pennsylvania, Ohio, Illinois, and Missouri.

At this port two-thirds of the merchandise imported into the United States is received and two-thirds of the import duties are collected. From this port are sent out one-half of the domestic products of the country which are exported, and here one-half of the foreign tonnage trading with the United States enters. Three-fourths of the passengers traveling between the United States and foreign countries come and go by way of New York, and three-fifths of all immigrants land at this port.

New York Harbor has two entrances—one by the East River and Hell Gate, leading into Long Island Sound, used chiefly by vessels trading between New York, the Eastern States, and the British American provinces; the other, which is the main entrance, leading out through the Narrows, by Sandy Hook, directly into the Atlantic Ocean.

The Hell Gate entrance had been in course of improvement since 1869, and with its successful completion, which is now assured within a few years, and with the steady growth of the city towards the north, it must come more than ever into use by foreign-bound vessels.

The main, or Sandy Hook, entrance into New York Harbor is one of the best in the world; the channel prior to 1884 was less than 24 feet deep at mean low water, and nearly 29 feet at mean high water, with abundant breadth, and was ample for all the commercial requirements of the port until the great increase in the length, tonnage, and draft of the transatlantic passenger steamers made further deepening necessary, in order to prevent the delays to which they were subjected by having to wait for high water in order to pass either in or out.

Before the improvement of the Main Ship Channel into New York Harbor was undertaken by the United States it was obstructed by 4 shoals, as follows:

1. The outer bar, about 4,000 feet wide, the channel across which is known as Gedney Channel, where there were depths of 23.7 feed in mid-channel and 22.3 in the southern half.

2. The shoal at the mouth of the Swash Channel, about 4,000 feet wide, where the depth was 24.3 feet.

The channel across this shoal has been named the Bayside Channel.

3. The shoal northeast of Sandy Hook, about 2,000 feet wide, on which the least depth was 26.2 feet.

4. The shoal in the Main Ship Channel in the Lower Bay, west of Flynn Knoll, nearly 3 miles long, on the crest of which the depth was only 23.9 feet in mid-channel, with depths of 22.6 feet within a few hundred feet of the mid-channel range.

A large proportion of the vast commerce of the port, which was carried on in vessels of great draft, could only cross these shoals at or near high water.

The reasonable demand which had been made in 1884 by commercial bodies residing in New York City that increased facilities should be afforded for entering the port of New York by the Sandy Hook route was recognized in the river and harbor act of July 5, 1884, which provided for "deepening Gedney Channel through Sandy Hook Bar, New York, $200,000."

A few words upon the subject of the Lower Harbor and of the various channels across the bar at the entrance are here necessary for a proper understanding of the causes which led to the adoption of the Main Ship Channel for improvement.

Gedney Channel is the main channel across the Ocean Bar, lying at the entrance to New York Harbor, about 3 miles outside of Sandy Hook and east by north of it. Sandy Hook lies about 9 miles outside of and nearly south from the Narrows, which is the name given to the strait separating the nearest points of Long Island and Staten Island, and the Narrows are about 7 miles south from the Battery, at the lower end of the city of New York. The Narrows are about 1 mile wide. That part of New York Harbor lying outside of the Narrows is commonly known as the Lower Bay.

From the Narrows northward to New York City there is no water less than 6 fathoms (36 feet) deep in the main channel.

Lower Bay is a large tidal basin, with an area of about 100 square miles, estimating inside or northward and westward of a line drawn from Sandy Hook to Coney Island.

The western end of the bay formed by Sandy Hook, the adjacent Jersey shore, and Staten Island, is known as Raritan Bay, and the southern part of it inside the peninsula of Sandy Hook is known as Sandy Hook Bay, or more commonly as the Horseshoe.

From the northeast around by the east to southsoutheast, the Lower Bay is open to the full sweep of the Atlantic Ocean.

From the Narrows to the northern point of Sandy Hook is about 9 miles, but the shortest distance across the bay from the point of Sandy Hook to Coney Island is 7 miles. The water cross section on this line at mean low water is about 790,000 square feet, through which the mean velocity is approximately 1.6 feet per second; but the maximum velocities are approximately twice as great (Board of Engineers' Report for 1884).

At the Narrows the channel is about 1 mile wide and 70 feet deep, with depths in it of over 100 feet.

Below the Narrows there is one main channel, commonly known as the Main Ship Channel, running southward to a point about 1 mile west of the upper end of Sandy Hook, thence turning at right angles northward and eastward for 4 miles to the head of Gedney Channel; and thence through Gedney Channel east to the deep waters of the ocean.

But along and inside the above-mentioned cross section of 7 miles between Sandy Hook and Coney Island there is a bar with five distinct channels running through it seaward and eastward of varying depths.

They lie in the following order, beginning at the northward:

(1) *The Coney Island Channel.*—In which the navigable depth at mean low water is 10 feet.

(2) *The Fourteen Foot Channel.*—In which the navigable depth at mean low water is 15 feet.

(3) *The East Channel.*—In which the navigable depth of water is 19 feet.

(4) *The Swash Channel.*—Through which 23 feet can be carried at mean low water in a narrow channel, but in which are two lumps, over which there is a depth of only 21.9 feet.

(5) *The Main Ship Channel.*—In which, prior to 1885, 24 feet only could be carried through channels with lumps in them with depths of 23.3 feet over them at mean low water. The northern reach, which passes along the west side of Flynn Knoll, is maintained by tidal flow through the Narrows; and the southern reach, along Sandy Hook, is maintained by tidal flow through Raritan Bay.

These five channels are separated by shoals with from 4 to 18 feet of water upon them at mean low water.

The first three of these channels head directly out into the open sea; but the two latter converge into an area of about 2 miles square, lying north and east of Sandy Hook, which has a depth in it of 30 feet of water and over, and from this deep area, seaward and eastward of it, two channels lead out into the open sea over the outer bar, the northernmost known as Gedney, the southernmost as the South Channel, both of which had prior to 1885 only 24 feet of water in them at low water. Gedney Channel is the wider and straighter of the two, and is therefore used by all the large vessels.

The Swash Channel is really a cut-off from the Main Ship Channel, leaving it about 6 miles below the Narrows, and joining it again at the western end of Gedney Channel.

Apart from being shoaler, the Swash is much narrower than the Main Ship Channel.

The distance from the Battery at New York to 30-foot soundings outside the bar in Gedney Channel is 22 miles, and by the Swash it is 18 miles, or from the Narrows 15 and 11 miles respectively.

As the appropriation of 1884 was made in advance of an approved project, the local officer was authorized and directed to make a survey of the Lower Harbor from the eastern end of Coney Island to Sandy Hook, with the view of determining the most feasible plan of improvement. The survey was completed in November, 1884, and a report recommending the eventual improvement of the Main Ship Channel, accompanied with estimates of cost and chart, was submitted December 6, 1884. (Annual Report Chief of Engineers, 1885, page 773.

The project provided for an improved channel 1,000 feet wide and 30 feet deep mean low water at a cost of $970,000.

The navigation of the Main Ship Channel inside the bar, especially on the approach to the Narrows from the Southwest Spit, is so intimately connected with that of Gedney Channel across the bar, that it was deemed important, in submitting an estimate of cost for the improvement of the latter channel directed to be made by Congress in the act of 1884, to extend the estimate to include the entire Main Ship Channel from the Narrows to the deep water beyond the bar, and to state that the improvements at the several intermediate shoals should take place simultaneously. The project providing for deepening the channel across the bar to 28 feet by dredging and for the contingent construction of a stone dike on the north side of the harbor, which had been recommended by a Board of Engineers December 24, 1884, received the approval of the Secretary of War December 27, 1884. (Annual Report Chief of Engineers, 1885, Part I, page 774).

The river and harbor act August 5, 1886, containing provisions for

continuing the improvement at the entrance to New York Harbor, read as follows:

Improving New York Harbor, New York: To secure a 30-foot channel at mean low water at Sandy Hook entrance of the harbor, upon such a plan as the Secretary of War may approve, $750,000.

By the specific wording of this act Congress gave an express approval of an improvement which contemplated a navigable channel 1,000 feet wide and 30 feet deep mean low water from the Narrows through the Main Ship Channel and Gedney Channel to deep water outside the bar, and all subsequent acts have confirmed the provisions of the act of 1886.

The river and harbor act of August 11, 1888, appropriated $380,000 for continuing the improvement.

The river and harbor act of September 19, 1890, appropriated $160,000 for continuing the improvement, making the total amount appropriated to date $1,490,000.

The estimated cost for opening the projected channel by dredging, revised in 1886, was fixed at $1,370,000, which was again increased in 1887 to $1,490,000.

The first operations began September 26, 1885, and the plant which has been used for the execution of the improvement has consisted solely of centrifugal pumps, and the excavations have been deposited beyond the bar in the vicinity of the Scotland light vessel.

The quantity which has been removed from the several reaches of the Main Ship Channel from September 26, 1885, to June 30, 1891, may be classified as follows:

	Cubic yards.
From Gedney Channel	1,055,090
From Bayside Channel	448,313
From Northwest Shoal	118,758
From west of Flynn Knoll	3,140,909
Total quantity excavated	4,763,070

The amount expended to June 30, 1890, inclusive of outstanding liabilities, was $1,135,696.80.

WORK DONE DURING FISCAL YEAR ENDING JUNE 30, 1891.

At the beginning of the fiscal year there was in force the contract with the Joseph Edwards Dredging Company, dated March 18, 1890, for the removal of 425,000 cubic yards of material, at 23½ cents per cubic yard, and the contract with the Brainard Dredging Company, dated November 26, 1889, for the removal of 1,000,000 cubic yards, at 16⅞ cents per cubic yard. Operations continued under the former contract until August 13, when it was completed, the work being done on the east side of the Main Ship Channel, north of Buoy No. 12.

On August 2 the Joseph Edwards Dredging Company's steam dredge *Advance*, employed under this contract, was struck by an incoming steamer and sunk in the Main Ship Channel north of the head of the Swash Channel. The wreck was removed by the Merritt Coast Wrecking Company, under contract with the owners, by September 20, 1890. She proved a total loss, and thereafter the work was carried on with the dredges *Reliance* and *Mount Waldo*.

No work was in progress under the contract with the Brainard Dredging Company, as their dredge *Leo* had been libeled for debt, and sold June 17, 1890. This dredge removed, up to the time of her withdrawal,

71,325 cubic yards. The dredge *Mount Waldo*, which had been put upon the work by the Brainard Dredging Company March 22, 1890, was withdrawn June 18, 1890, after having removed 168,757 cubic yards under this contract. The contractor having no plant upon the work, the contract was annulled July 21 by direction of the Secretary of War, dated July 17, 1890. The Joseph Edwards Dredging Company, the next lowest bidder under proposals opened October 17, 1889, was awarded the balance remaining under this contract, according to the terms of its bid, and a contract was entered into with it under date of August 13, 1890, for the removal of 530,000 cubic yards, at 22.6 cents per cubic yard. Operations under this contract began August 13 and continued until February 6, 1891, when it was completed. The work was done on the west side of the Main Ship Channel from Buoy No. 10 north to Buoy No. 12.

The river and harbor act of September 19, 1890, appropriated $160,000 for completing the improvement. The project for the expenditure of this sum, approved by the Chief of Engineers September 29, 1890, provides for the completion of improvement by dredging the uncompleted channels to the full width of 1,000 feet and full depth of 30 feet mean low water contemplated in the original project. Proposals were invited by public advertisement, to be opened January 22, 1891, for the removal of 500,000 cubic yards of material from the Main Ship-Channel. Only one bid was received under this advertisement, and was offered by the Joseph Edwards Dredging Company at 23.9 cents per cubic yard. Contract bearing date February 16, 1891, was made under this proposal, and operations were continued until the close of the year. The work under this contract was done on the west half of the Main Ship Channel from Buoy C 5 northward to deep water below the Narrows. A table showing the quantity of material removed under the various contracts during the year is appended.

A resurvey of the Main Ship Channel from Buoy No. 10, Lower Bay north to deep water below the Narrows, was made during October, November, and December, 1890, and charts published for distribution. The survey showed that the Main Ship Channel from Buoy No. 10, Lower Bay northward to Buoy No. 12, had then a depth of 30 feet mean low water for a width varying from 500 to 800 feet and a depth of 28 feet, mean low water for a width of 1,000 feet throughout. From Buoy No. 12 northward to deep water below the Narrows there was then a 30-foot channel 400 feet wide and a 28-foot channel 1,000 feet wide. The 30-foot channel had a least width of 400 feet from deep water below Buoy No. 10 Lower Bay to deep water below the Narrows, a distance of 22,000 feet, and there was a 28-foot channel 1,000 feet wide throughout the entire length of this reach.

Surveys of the improved channels, extending from across Gedney Channel to deep water below the Narrows, are in progress.

The map of Gedney Channel, which has been prepared from this survey, shows that there has been no noticeable deterioration of the channel since the last survey, which was made January, 1890. This is a most gratifying result, as the bar during the interval of 18 months has been subjected to frequent prolonged attacks by storm waves of more than ordinary virulence, following heavy easterly and northeasterly weather. The office has received during the year no complaint from any source of deficient depth at any point in the Main Ship Channel. If vessels have grounded at all, it has been upon the littoral shoals and not in the channel.

When the project is completed and the Main Ship Channel has every-

where from the Narrows to the sea beyond the bar a full width of 1,000 feet and a least depth of 30 feet mean low water, there will be ample water facilities for the passage of the bar at all stages of the tide by the deepest draft vessels.

While it is expected that the present contract will complete the approved project for this work, it is deemed proper to state that provision should be made for unforeseen shoalings which are liable to occur, and which, if disregarded, will interfere seriously with the commerce of the port of New York. It would seem, therefore, wise to provide for the construction of a suction dredge, such as has been used in effecting the improvement, to be operated by hired labor and to be kept constantly in commission, working on all portions of the improved channels and at such other places in the harbor as may require dredging to afford relief. The cost of building a steam suction dredge provided with self-containing bins and arranged so as to pump into scows, if at any time it should prove expedient, of sufficient capacity to do economic work, would be, approximately $100,000. The running expenses of the dredge, including ordinary repairs, would be about $6,000 per month, or $72,000 per year.

An appropriation of $250,000 is recommended for the construction of such a dredge, and to provide for running expenses for 2 years.

At the beginning of the fiscal year there was in force the contract with J. S. Howell, dated May 12, 1890, for the delivery of 5,000 tons of broken stone, at 90 cents per ton. By November 1, 5,784 tons of stone were delivered under this contract and placed in position in the sea wall for the protection of the north shore of Sandy Hook. The wall at that time extended from jetty No. 4 to jetty No. 10.

Proposals were invited by public advertisement and opened March 16, 1891, for the delivery of 5,000 tons of large stone at Sandy Hook for additional shore revetment from jetty No. 4 to jetty No. 1, and from jetty No. 10 to jetty No. 11, and also additional stone to provide for settlement along the whole wall. A contract was entered into with Mr. John Satterlee, the lowest bidder, dated March 26, 1891, for the delivery of 5,000 tons of broken stone, at 79 cents per ton. At the close of the year 2,511 tons have been delivered and placed in position, and the sea wall has been extended 375 feet eastward from jetty No. 4 to jetty No. 1, and 200 feet westward from jetty No. 10 towards jetty No. 11.

The wall was begun last summer as a rough rubble wall joining existing jetties; it has an average profile of 15 feet width on the bottom, 5 feet width on the top, and 5 feet height; and when the work was suspended in October had a total length of about 1,800 feet. The average weight of stone used per running foot was 3.2 tons, and the cost $6.02 per running foot, or $1.88 per gross ton in place. The wall is being extended with the same cross section, and the cost will be about the same. The specifications require that the stone shall be in pieces weighing not less than 300 pounds and not more than 3 tons.

After the wall is finished to jetty No. 11 that portion built last summer will be repaired by adding stone to it to raise it again to its original height, as it was settled bodily in many places through the action of the high storms during the winter. It was anticipated that this settlement would take place.

The action of the wall during the winter was most favorable, as sand filled in progressively behind it and gave entire protection to the sand dunes in rear. The beach in front of the wall underwent no permanent change; at times it grew by extensive accumulations of sand, which in

turn were reduced or carried away when the direction of the incoming waves was changed.

Westward of the western end of the wall, near jetty No. 10, the sand dunes were attacked and serious inroads were made in them. The proposed extension of the wall will cover this exposed front.

The total length of the wall when finished as proposed will be 2,575 feet. At some future time it may be necessary to extend the wall beyond jetty No. 11 or to raise it again until the stone ceases to settle in the sand.

This additional work will be contingent upon the violence of the wave action against the wall while it is new and before final settlement is reached.

This improvement by dredging, as well as others of a similar character in and about New York Harbor, has been under the local charge of Mr. G. W. Kuehnle, assistant engineer, during the year, to whom I am indebted for the most satisfactory and intelligent manner in which he has discharged his various duties.

The special work of shore protection at Sandy Hook has been under the personal direction of Lieut. Harry Taylor, Corps of Engineers, assistant.

Statement of material removed under the various contracts during the fiscal year ending June 30, 1891.

	Cubic yards.	Cubic yards.
Under contract with the Joseph Edwards Dredging Company, dated March 18, 1890, for the removal of 425,000 cubic yards from the Main Ship Channel (completed August 13, 1891):		
Reliance	51,655	
Advance	34,295	
Mt. Waldo	105,362	
		191,312
Under contract with the Joseph Edwards Dredging Company, dated August 13, 1890, for the removal of 530,000 cubic yards from the Main Ship Channel (completed February 6, 1891):		
Reliance	189,460	
Mt. Waldo	340,540	
		530,000
Under contract with the Joseph Edwards Dredging Company, dated February 16, 1891, for the removal of 500,000 cubic yards from the Main Ship Channel:		
Reliance	123,666	
Mt. Waldo	163,119	
		286,785
Total		1,008,097

This work is in the collection district of New York. Nearest light-houses, Sandy Hook and Highland Lights. The nearest forts are the fort at Sandy Hook and those at the Narrows.

Amounts appropriated.

For Gedney Channel:	
By act July 5, 1884	$200,000
For New York Harbor:	
Act August 5, 1886	750,000
Act August 11, 1888	380,000
Act September 19, 1890	160,000
Total	1,490,000

Amount expended to June 30, 1891, inclusive of outstanding liabilities, $1,406,188.89.

Money statement.

July 1, 1890, balance unexpended		$233,516.85
Amount appropriated by act approved September 19, 1890		160,000.00
		393,516.85
June 30, 1891, amount expended during fiscal year		273,400.28
July 1, 1891, balance unexpended		120,116.57
July 1, 1891, outstanding liabilities	$36,305.46	
July 1, 1891, amount covered by uncompleted contracts	52,924.70	
		89,230.16
July 1, 1891, balance available		30,886.41
Amount that can be profitably expended in fiscal year ending June 30, 1893 Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		250,000.00

Abstract of proposal for dredging in New York Harbor, received in response to advertisement dated December 22, 1890, and opened January 22, 1891, by First Lieut. Harry Taylor, Corps of Engineers, in the official absence of Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Dredging 500,000 cubic yards of material from the main ship channel, north of buoy No. C 6.	
		Per cubic yard.	Amount.
1	The Joseph Edwards Dredging Co	*$0.23 3/10	$119,500

* Only bid received.

Abstract of proposals for the delivery of large stone at Sandy Hook, New Jersey, for shore revetment, received in response to advertisement dated February 10, 1891, and opened March 16, 1891, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Large stone, delivered at Sandy Hook, 5,000 tons.	
		Per gross ton.	Amount.
1	Alex. J. Howell	$1.22	$6,100
2	William H. Molthrop & Co	2.00	10,000
3	John Satterlee	*.79	3,950
4	Francis H. Smith	1.39	6,950
5	North River Blue Stone Co	1.13	5,650
6	P. J. Nevins	2.25	11,250
7	Charles A. Brown	.83	4,150

* Lowest bid.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1891, have remained practically unchanged, and therefore those reported for the year 1890 are herein repeated.

The following statement concerning the commerce of New York Harbor is taken from the Report of the Chamber of Commerce of the State of New York for the year 1889–'90:

Articles.	Imported.		Exported.		Total value.
	Quantity.	Value.	Quantity.	Value.	
Sugar.....pounds..	1,463,051,343	$42,943,453	.....	.....	$42,943,453
Molasses.....gallons..	8,498,875	1,424,251	.....	.....	1,424,251
Coffee.....pounds..	455,979,016	58,860,319	.....	.....	58,860,319
Tea.....do....	58,476,531	9,643,514	.....	.....	9,643,514
Manufactures of wool, silk, cotton, and flax.....	.....	111,234,883	.....	$7,728,397	118,963,280
Cotton.....	.....	.....	536,614,048	54,701,315	54,701,315
Leather and hides.....	.....	25,760,160	.....	4,906,214	30,666,374
Tin.....pounds..	327,279,151	14,825,588	.....	.....	14,825,588
Raw silk and wool.....do....	55,505,689	13,949,577	.....	.....	13,949,577
Hemp, jute, sisal grass, etc..tons..	149,263	13,431,215	.....	.....	13,431,215
India rubber and gutta percha, crude.....pounds..	28,652,361	11,094,063	.....	.....	11,094,063
Tobacco and manufactures.....	.....	10,147,883	.....	15,291,084	25,438,967
Furs and manufactures.....	.....	4,748,971	.....	4,724,017	9,472,988
Earthen, stone, and china ware...	.....	3,230,780	.....	.....	3,230,780
Wines.....	.....	6,156,821	.....	.....	6,156,821
Coin and bullion.....	.....	7,274,618	.....	69,724,274	76,998,892
Precious stones.....	.....	9,498,209	.....	.....	9,498,209
Miscellaneous.....	.....	135,203,820	.....	75,006,102	210,209,922
Breadstuffs:					
Wheat.....bushels..	.....	.....	9,086,407	8,449,510	8,449,510
Wheat flour.....barrels..	.....	.....	3,335,195	15,498,193	15,498,193
Corn.....bushels..	.....	.....	26,658,970	13,066,961	13,066,961
All other breadstuffs.....	.....	.....	.....	1,765,287	1,765,287
Provisions.....pounds..	.....	.....	753,007,846	64,504,425	64,504,425
Mineral oils.....gallons..	.....	.....	418,773,072	36,049,956	36,049,956
Cattle.....	.....	.....	75,004	6,204,624	6,204,624
Oil cake and meal.....pounds..	.....	.....	231,034,183	3,032,066	3,032,066
Foreign merchandise.....	.....	.....	.....	16,727,560	16,727,560
Total.....	.....	479,428,125	.....	397,379,985	876,908,110

This table shows an increase of $24,642,419 over the total value of imports and exports for the preceding year, which amounted to $852,165,691.

The amount of revenue collected for the port of New York for the fiscal year ending June 30, 1891, was $147,538,045.69.

LETTER OF MR. J. J. COUCH, SPECIAL DEPUTY COLLECTOR.

CUSTOM-HOUSE, NEW YORK, COLLECTOR'S OFFICE,
July 29, 1891.

SIR: Referring to your letter of the 9th inst. relating to the commerce of this port for the fiscal year ending June 30, 1891, I return herewith the forms you transmitted and the information requested.

The values given in the schedule do not include merchandise imported and entered for immediate export, amounting to $27,049,802, nor merchandise imported for immediate transportation to other ports, amounting to $28,393,316.

Respectfully yours,

J. J. COUCH,
Special Deputy Collector.

Lieut. Col. G. L. GILLESPIE, U. S. A.

Statement of the number and tonnage of all vessels belonging to the port of New York, June 30, 1891.

	Number.	Registered tonnage.
Steam vessels	994	385,580.02
Sailing vessels	1,444	281,048.14
Barges	616	133,939.56
Canal boats	30	4,543.27

Commercial statistics of the port of New York for the fiscal year ending June 30, 1891.

Amount of revenue collected	$147,538,045.69
Value of all imports	537,786,007.00
Value of all exports	346,528,847.00

	Number.	Registered tonnage.
Foreign vessels entered	3,911	5,480,049
Foreign vessels cleared	3,805	5,260,333
American vessels from foreign ports	1,375	923,015
Coastwise vessels entered	2,482	2,980,576
Coastwise vessels cleared	2,928	3,270,300

E 11.

IMPROVEMENT OF RARITAN BAY, NEW JERSEY.

Raritan Bay forms the western part of the large triangular bay inclosed between Sandy Hook, the New Jersey shore, and Staten Island, the eastern part of which is commonly known to New Yorkers as the Lower Bay, as it lies just outside of or below New York Harbor, which is the name usually applied to the inner body of water on which the city of New York is situated.

The Raritan River flows into Raritan Bay at its extreme western end, passing between Perth Amboy and South Amboy, and Newark Bay is connected with both the Raritan River and Bay by the Arthur Kill or Staten Island Sound, which, separating Staten Island, belonging to the State of New York, from the New Jersey shore, enters Raritan Bay at Perth Amboy.

The depth of the bay varies from 5 to 30 feet, decreasing gradually towards its western and southern shores.

The natural channel leading out of it towards the eastward, after passing the Great Beds Light at the junction of Staten Island Sound and the Raritan River, does not follow the middle of the bay, but hugs the Staten Island shore for nearly 4 miles to Seguine Point, situated about half a mile east of Prince Bay Light, thence it runs southeastwardly towards the inner point of Sandy Hook, about 2 miles, crossing a shoal which puts out towards the southward from the Staten Island shore.

In 1880, before any improvement had been made here by the Government, 18 feet at mean low water could be carried through from Perth Amboy to Great Beds light; while there was not less than 21 feet of water from Great Beds Light to Seguine Point, to deep water in the outer bay only 14½ feet of water could be carried across the shoal.

The width of this shoal between the 21-foot curves was about 8,000 feet.

Through the middle of the bay, south of this channel from Great Beds Light directly towards Sandy Hook, only 11 feet of water could be carried over the shoals.

The above depths all refer to mean low water.

A survey of this bay was ordered in 1880, with the view of ascertaining the practicability of securing a greater depth of water from the main ship channel in the Lower Bay to the wharves at Perth Amboy, as vessels were often much delayed in crossing the shoal east of Seguine Point.

The estimated cost of dredging a channel 300 feet wide and 21 feet deep, mean low water, from Seguine Point southwestward to the deeper waters of the bay outside was $126,500. (Annual Report Chief of Engineers, 1881, Part I, pages 717–719.)

From March 3, 1881, to July 5, 1884, $120,000 were appropriated for this improvement, and a survey which was made in May, 1885, showed that the improved channel at that date had an average width of 250 feet, and a least depth of 18 to 20 feet mean low water.

The channel had slightly shoaled since the dredging was suspended in 1884. In 1885 the project was extended by providing for excavating a channel 300 feet wide and 21 feet deep, from Great Beds Light to deep water at Ward Point, opposite Perth Amboy. This channel, taken in connection with its extension to the eastward of Seguine Point, would give a continuous 21-foot channel from the Main Ship Channel in New York Bay to the wharves at Perth Amboy. The modified project of 1885 further called for dredging a channel from Great Beds Light to South Amboy, 4,500 feet long, 300 feet wide, and 15 feet deep, mean low water. The cost of dredging these two channels and restoring the original width in the cut, east of Seguine Point, was estimated to cost $114,000, which sum was increased in 1888 to $120,000, to provide for the shoaling which had taken place in the interval of three years. (Annual Report of the Chief of Engineers, 1885, Part I, page 758.) The appropriation, act of August 5, 1886, was $37,500, and was applied to completing the channel west of Ward Point, 300 feet wide and 21 feet deep, and in excavating a channel 315 feet wide and 21 feet deep across the crest of the shoal leading from the bend towards Seguine Point, but the funds were not sufficient to complete the whole of the projected work at that point.

It was stated in the original project of 1881 that the Seguine Point Channel would have to be maintained by dredging. The detailed survey which was made in 1888, from the eastern end of the Seguine Point Channel to Perth Amboy, showed that considerable shoaling had taken place both in the improved channel and over a large stretch west of Prince Bay Light, where deep water formerly existed. This fact made it necessary, in 1889, to submit revised estimates for the further improvement of the channels leading to Perth Amboy and to South Amboy. (Annual Report of the Chief of Engineers, for 1889, Part I, page 796.)

REVISED ESTIMATES.

1. For a channel 300 feet wide and 21 feet deep, mean low water, from New York Lower Bay to Perth Amboy, the following dredging will be required:

	Cubic yards.
(*a*) From 21-foot curve, New York Lower Bay, to 21-foot curve off Seguine Point	347,368
(*b*) From Prince Bay around Red Buoy 8, towards Great Beds Light.	154,130
Total dredging	501,498

2. For a channel 300 feet wide and 15 feet deep from Great Beds Light to South Amboy, the dredging required will be 200,000

These estimates are made on the basis of an allowance of 1 foot over depth, and for one-third increase in bulk for scow measurement.

Total dredging required for the completion of the two projected channels	cubic yards	701,498
Estimated cost of the proposed dredging		$175,375

The river and harbor act of August 11, 1888, appropriated $25,000 for continuing the improvement, and on the 27th of February, 1889, contract was made with James A. Simmons, of New York city, for the removal of 120,000 cubic yards of material from Raritan Bay; 80,000 cubic yards to be removed from the channel across the shoal off Seguine Point, securing 21 feet depth; and 40,000 cubic yards from the channel leading across shoal at Great Beds Light to South Amboy, securing 15 feet depth, mean low water.

The river and harbor act of September 19, 1890, appropriated $40,000 for continuing the improvement.

It may be said in regard to this improvement that the deep-water channel which has been said to hug the south shore of Staten Island as far east as Seguine Point is the *ebb* channel, while the channel on the southern border of Round Shoal through the center of the bay, which heads on the line joining Seguine Point, north shore, and Conaskonk Point, south shore, is the *flood* channel. These two channels slightly overlap, passing each other at a distance of 7,000 feet.

The connection of these two channels by an improved channel starting at Seguine Point and running southeast towards Sandy Hook is an unnatural connection, and it was stated in the original report, in 1881, that the channel so projected would require annual dredging for its maintenance.

The experience of all the contracts which have been made for this improvement confirms the prediction of 1881. It would have been better had sufficient funds been available in the beginning, to have extended the flood channel by dredging almost due west until it intersected the ebb channel a short distance to the east of the Great Beds Light. Then the ebb and flood would have probably followed the same path, and there would have been a better prospect of having the common channel maintained by tidal scour.

The width of the intervening shoal is about 12,000 feet, and the average depth of water is 13 feet, approximately, between the 21-foot curves. The amount of material necessary to be removed to open a channel on this line 300 feet wide and 21 feet deep, is 2,400,000 cubic yards, at an estimated cost of $600,000.

While it is probable that this will be the future channel which will connect the head of Raritan Bay with the Amboys, the present condition of the commerce incident to the western end of the bay does not justify so radical a change in the existing project as that indicated in the estimate just given. A limited amount of dredging may be done annually in the Seguine Point Channel to maintain a 21-foot depth for vessels until commerce has so largely increased as to demand a more direct and convenient route across the shoal now lying at the western end of the bay.

WORK DONE DURING THE FISCAL YEAR ENDING JUNE 30, 1891.

No operations were in progress at the beginning of the fiscal year.

The river and harbor act of September 19, 1890, appropriated $40,000 for continuing the improvement, "one-half of which may be expended

in dredging bar between South Amboy and Great Beds Light." A project for the expenditure of this appropriation received the approval of the Chief of Engineers September 27, 1890; under this project proposals were invited by public advertisement, to be opened November 21, for dredging 100,000 cubic yards of material from the channel off Seguine Point, and 90,000 cubic yards of material from the channel leading to South Amboy. The bid of Thomas Potter, the lowest bidder, was accepted and contract entered into with him January 16, 1891, at $16\frac{2}{3}$ cents per cubic yard for material dredged from Seguine Point Channel, and $18\frac{3}{4}$ cents per cubic yard for material dredged from channel leading to South Amboy.

Operations began under this contract April 15, on South Amboy Channel, with one dredge. At the close of the fiscal year 82,035 cubic yards had been removed, resulting in a channel 170 feet wide and 15 feet deep, mean low water.

Work will begin on the Seguine Point Channel about July 15.

An appropriation of $50,000 is recommended for continuing the improvement along the channels leading to Perth Amboy and South Amboy, respectively.

This work is in the collection district of Perth Amboy, which is the nearest port of entry. Nearest light-house, Prince Bay. Nearest fort, fort at Sandy Hook, New Jersey.

Amounts appropriated.

Application.	Date.	Amount.
Dredging	Mar. 3, 1881	$50,000
Do	Aug. 2, 1882	50,000
Do	July 5, 1884	20,000
Do	Aug. 5, 1886	37,500
Do	Aug 11, 1888	25,000
Do	Sept. 19, 1890	40,000
Total		222,500

Amount expended to June 30, 1891, inclusive of outstanding liabilities, $197,680.02.

Money statement.

July 1, 1890, balance unexpended		$1,939.72
Amount appropriated by act approved September 19, 1890		40,000.00
		41,939.72
June 30, 1891, amount expended during fiscal year		9,889.48
July 1, 1891, balance unexpended		32,050.24
July 1, 1891, outstanding liabilities	$7,230.26	
July 1, 1891, amount covered by uncompleted contracts	18,160.11	
		25,390.37
July 1, 1891, balance available		6,659.87
Amount (estimated) required for completion of existing project		135,375.00
Amount that can be profitably expended in fiscal year ending June 30, 1893		50,000.00
Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867.		

Abstract of proposals for improving Raritan Bay, New Jersey, received in response to advertisement dated October 15, 1890, and opened November 21, 1890, by Lieut. Col. G. L. Gillespie, Corps of Engineers.

No.	Name of bidder.	Channel off Seguine Point. Available, $17,000.		Channel from Great Beds Light to South Amboy, N. J. Available, $17,000.	
		Per cubic yard.	Quantity that can be removed at price bid.	Per cubic yard.	Quantity that can be removed at price bid.
			Cubic yards.		*Cubic yards.*
1	Atlantic Dredging Company	$0.16⅛	102,000	$0.19	89,474
2	W. H. Beard				
3	Thomas Potter	*.16⅛	102,000	*.18¾	90,666
4	Morris & Cumings Dredging Company	.18	94,444	.22	77,273

* Lowest bid.

NOTE.—Total amount available for the work, $34,000.

COMMERCIAL STATISTICS.

The commercial statistics for the fiscal year ending June 30, 1891, have remained practically unchanged, and therefore those reported for the year 1890 are herein repeated.

The following statement of the commerce of South Amboy, N. J., and of Raritan River was prepared by Hon. D. C. Chase, mayor of South Amboy, N. J.

Receipts and shipments.

Articles.	Quantity.
	Tons.
Products of the forests	33,851
Products of quarries and mines	3,020,003
Animal products	16,541
Agriculture	37,557
Manufactures	417,909
Mechanical and miscellaneous	320,005
Total	3,845,866

Total value, $45,075,943.

Vessels arriving and departing.

Class.	Number.	Tonnage.	Draft (loaded).
			Feet.
Steamers	6,038	359,300	6 to 12
Barks	40	8,800	8 16
Brigs	40	8,800	8 16
Schooners	4,138	248,280	7 14
Sloops	1,002	52,210	5 7
Propellers	4,028	280,682	7½ 10
Barges and lighters	45,838	2,887,794	7 16
Total	61,124	3,845,866	

The following statement of the commerce of Perth Amboy, N. J., for the year 1889 was received from Mr. James Donnelly, superintendent of the New Jersey division, Lehigh Valley Railroad Company:

Lehigh Valley Railroad tonnage eastward and westward over the wharves for the year 1889.

[Gross tons.]

	Received.	Shipped.	Total.
Coal piers.			
Coal	.....	1,815,521	
Coke	.....	3,058	
			1,818,579
Freight wharves.			
Grain	.....	125,743	
Steel rails	.....	34,052	
Pig-iron	471	87,796	
Iron ore	86,194	.....	
Lumber	33,207	875	
Fertilizer	106	.....	
Clay	.....	5,662	
Miscellaneous	5,867	7,732	
			387,705
United Refiners' Export Oil Company's wharf.			
Oil	.....	60,867	60,867
Grand total	.....	.....	2,267,151

Number, tonnage, and draft of vessels.

	Number.	Tonnage.	Draft.
Vessels transporting coal.			*Feet.*
Steam	102	500 to 3,000	.....
Sailing	848	50 1,200	.....
Barges	311	500 1,200	.....
Boats	4,821	100 400	.....
Vessels transporting freight.			
Ocean steamers	10	1,500 3,500	19 to 23.5
Sailing vessels	181	500 1,200	15 18
Lighters	57	200 500	6 13
Canal boats	1,238	200 300	6
Company's wharf.			
Barks and ships	59	500 1,500	15 18

Commercial statistics of the port of Perth Amboy, N. J., for the fiscal year ending June 30, 1891.

Amount of revenue collected	$16,584.13
Value of all imports	58,133.00
Value of all exports	1,207,089.00

	Number.	Registered tonnage.
Foreign vessels entered	14	12,759
Foreign vessels cleared	61	50,046
American vessels from foreign ports	8	3,232
Coastwise vessels entered	98	68,959
Coastwise vessels cleared	56	31,632

Statement of the number and tonnage of all vessels belonging to the port of Perth Amboy, N. J., June 30, 1891.

	Number.	Registered tonnage.
Steam vessels	47	8,140.25
Sailing vessels	289	18,499.06
Barges	69	22,715.74
Canal boats	1	139.28
	406	49,494.33

E 12.

REMOVING SUNKEN VESSELS OR CRAFT OBSTRUCTING OR ENDANGERING NAVIGATION.

(1) Schooner Salamander, Raritan Bay, New Jersey.—The schooner *Salamander* was sunk in Raritan Bay opposite the southern shore of Staten Island on October 19, 1890. The length of the schooner is 53 feet, beam 18 feet, depth 4.8 feet, and net tonnage 26 tons, approximately. Her cargo consisted of fire brick and clay.

The wreck and cargo were successfully removed by January 21, 1891, by Mr. John F. Baxter, the lowest bidder under proposal approved by the Chief of Engineers December 24, 1890. The cost of the removal was $495.

(2) Schooner Francis E. Hallock.—The schooner *Francis E. Hallock* was run down by the collier *Clarence H. Verner* on November 29, 1890, about 10 miles SE. by S. ½ S. of Barnegat Light. She was taken in tow by a tug with the purpose of bringing her to New York, but was finally abandoned December 2 north of Gedney Channel in the deep hole south of the eastern entrance to East Channel. The length of the schooner is 119 feet, beam 31 feet, depth 7.8 feet, and net tonnage 204 tons.

The wreck was successfully removed by April 23, 1891, by the Merritt Coast Wrecking Company, the lowest bidder under proposal approved by the Chief of Engineers January 30, 1891. The cost of the removal was $1,500.

E 13.

PRELIMINARY EXAMINATION OF BUTTERMILK CHANNEL AND GOWANUS BAY CHANNELS IN NEW YORK HARBOR, NEW YORK.

[Printed in House Ex. Doc. No. 26, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated October 17, 1890, from Lieut. Col. G. L. Gillespie, Corps of Engineers, giving results of preliminary examination of "Buttermilk Channel and Gowanus Bay Channels in New York Harbor, with a view of straightening the same by removing the shoals opposite the southeast side of Governors Island, protecting the channels by a sea wall on Governors Island, and to provide for the full width thereof a uniform depth of 26 feet at mean low water throughout these channels along the wharves of Brooklyn, from a point opposite Wall Street Ferry to the foot of Bryant street, Brooklyn," made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Gillespie reports that he does not think Gowanus Bay is worthy of improvement to the extent contemplated or proposed to be effected by the act, and I concur in his views.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

HON. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 17, 1890.

GENERAL: In obedience to letter from the Chief of Engineers dated September 20, 1890, I have the honor to submit the following report on the preliminary examination of "Buttermilk Channel and Gowanus Bay Channels in New York Harbor, with a view of straightening the same by removing the shoals opposite the southeast side of Governors Island, protecting the channels by a sea wall on Governors Island, and to provide for the full width thereof a uniform depth of 26 feet at mean low water throughout these channels, along the wharves of Brooklyn, from a point opposite Wall Street Ferry to the foot of Bryant street, Brooklyn," to comply with the requirements of the river and harbor act of September 19, 1890.

Buttermilk Channel is the water way on the east side of Governors Island which connects the Upper Bay of New York Harbor with the western entrance to East River; and the "Gowanus Bay Channels" of the act are the combined water ways known as Red Hook and Gowanus Creek Channels, which connect Buttermilk Channel with Gowanus Bay.

As these channels were surveyed during the past summer for the purpose of ascertaining the condition of the improvement at the close of the working season and of providing information for the preparation of estimates for future work, additional surveys will not be necessary to be made for a compliance with the requirements of the act of September 19, 1890.

The "shoals opposite the southeast side of Governors Island," to which reference is made in the act, are known locally as Red Hook Shoal, which extends from the entrance to Atlantic Basin southwest along the Brooklyn shore 3,000 feet, approximately, to Red Hook. Its width, measured northwestward, from the Brooklyn shore, is 1,000 feet, approximately, and the least depth over it at mean low water is 7.2 feet. It is composed chiefly of sand and small bowlders, overlying clay, and contains about 1,484,048 cubic yards of material, scow measurement, above the 26-foot contour, including one-half foot overdepth and 30 per cent. increase in bulk.

The effect of the shoal is to obstruct the set of the currents and to deflect the channel northward toward the southern shore of Governors Island, thereby giving to the water passage along the Brooklyn shore a circuitous direction.

The approved projects for improvement in the Upper Harbor, extending through East River to the Sound, provide for a depth of 26 feet at mean low water, and as the Buttermilk Shoal, at the eastern entrance to Buttermilk Channel, will be wholly removed by December of this year to that depth under a contract now in progress, it would seem advisable that the Red Hook Shoal should likewise be removed so as to afford everywhere over it a depth of 26 feet, mean low water. When this removal takes place Buttermilk Channel opposite the Atlantic Basin will be 1,000 feet wide, and the set of the currents will be so direct along the southern margin of Governors Island that the improved depths will be maintained, with reasonable certainty, without assistance from artificial banks.

For this reason the building of a sea wall on the southeast side of Governors Island to protect this part of the channel after improvement, is not a work which it is expedient to estimate for at this time. Its consideration will therefore be omitted.

GOWANUS BAY.

Gowanus Bay is a natural basin on the west shore of South Brooklyn, and may be regarded as forming part of the Upper Bay of New York Harbor, from which it is separated by a long shoal running southwest, over which the least depth is 9 feet, mean low water.

It is connected on the north with the Buttermilk Channel by the Red Hook Channel; and on the south with the lower part of the upper bay of New York Harbor by the Bay Ridge Channel. The width at the entrance is 2,000 feet, approximately; at Henry street (on the north shore) the proper mouth of Gowanus Creek, the width is reduced to 400 feet; and at Hamilton avenue, the eastern terminus of the creek, the width of the channel is barely 100 feet. At the foot of Bryant street (mentioned in the act) the width of the creek between established pierhead lines is 250 feet, approximately.

The approval project for the improvement of Gowanus Bay and Creek, and of their connecting channels with the Upper Bay, provides for a depth of 21 feet, mean low water, and is now in process of execution.

The width which it is proposed to give to these channels is not clearly defined in the act of September 19, 1890, which reads as if the existing channels were of uniform width, whereas, in fact, the Buttermilk Channel is 1,000 feet, Red Hook Channel 400 feet, and Gowanus Creek Channel from 100 to 250 feet wide.

The evident intention of the act is to provide for increased depth only, leaving the existing widths in the several channels unchanged.

With this interpretation of the act, the quantity of material necessary to be removed in order to give 26 feet depth, mean low water, through Red Hook and Gowanus Creek Channels "to the foot of Bryant street, Brooklyn," is 1,675,557 cubic yards, scow measurement, allowing one-half foot over depth and 30 per cent. increase in bulk.

The total estimate for the entire work, prepared from data furnished by the survey of July, 1890, may be stated as follows, scow measurement.

	Cubic yards.
Removal of Red Hook Shoal to a depth of 26 feet, mean low water	1,484,048
Deepening Red Hook and Gowanus Creek Channels to 26 feet, mean low water, from the entrance to Erie Basin southward and eastward to the foot of Bryant street	1,675,557
Total excavation	3,159,605

These channels, it can not be denied, are most important water ways accessory to the harbor of New York, and their improvement so as to afford 26 feet depth, mean low water, or some approximate depth, will undoubtedly be demanded in time to meet the requirements of larger vessels than those which now use them.

It is important that Red Hook Shoal should be removed, but there seems to be no occasion for increasing the depth in Red Hook and Gowanus Bay channels to 26 feet, which is more than the present commerce of Gowanus Bay needs or which will be needed by any probable commerce of that bay in the near future.

I do not therefore think that Gowanus Bay is "worthy of improvement" to the extent contemplated, or proposed to be effected, by the act. The present project for improvement, which provides for a depth of 21 feet, mean low water, will on completion meet every present need, and no examination or survey of the channel through the bay, or of

any connecting channel, is necessary for the purpose of preparing estimates for any depth in excess of the projected depth of 21 feet, mean low water.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

E 14.

PRELIMINARY EXAMINATION OF BAY RIDGE CHANNEL, WITH A VIEW OF REMOVING THE SHOAL AND PROVIDING A UNIFORM DEPTH OF 23 FEET AT MEAN LOW WATER OPPOSITE THE BAY RIDGE SHORE TO THE 23-FOOT CURVE IN THE NEW YORK HARBOR.

[Printed in House Ex. Doc. No. 60, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 5, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report, dated October 17, 1890, from Lieut. Col. G. L. Gillespie, Corps of Engineers, giving results of preliminary examination of Bay Ridge Channel, with a view of removing the shoal and providing a uniform depth of 23 feet at mean low water opposite the Bay Ridge shore to the 23-foot curve in the New York Harbor, made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Gillespie reports that he does not think the Bay Ridge Channel worthy of improvement at this time to the extent specified in the act, and I concur in his views.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York City, October 17, 1890.

GENERAL: In compliance with letter of the Chief of Engineers dated September 20, 1890, I have the honor to submit the following report in regard to the provisions contained in the river and harbor act of September 19, 1890, with reference to the improvement of Bay Ridge Channel, New York.

Bay Ridge Channel is a water way which leads from the southern part of the upper bay of New York Harbor northward along Bay Ridge and eastward along the south shore of Gowanus Bay to Twenty-eighth street, South Brooklyn.

Up to Sixtieth street it has a width of 200 feet and a depth of 21 feet, mean low water; thence the depth diminishes to 15 feet, mean low

water, at Fortieth street, and to 7 feet at Twenty-eighth street. Formerly, the channel adopted for improvement, after reaching Fortieth street, ran northeasterly across the entrance to Gowanus Bay and united with the Red Hook Channel, which enters Gowanus Bay from the north, near the southwest corner of Erie Basin.

The project for improvement, based on the survey of 1880, provided for a channel 200 feet wide and 18 feet deep. Work was begun at the southern end, and when operations ceased in 1884 its northern terminus, near Fortieth street, was separated from the Red Hook Channel entrance to Gowanus Creek by a distance of 2,000 feet, over which the least depth did not exceed 10 feet mean low water.

By the river and harbor act of September 19, 1890, the direction which had been given originally to this channel was changed, and an appropriation of $100,000 was made for dredging and opening the channel "from a point at its junction with the Gowanus Creek Channel (near Twenty-eighth street), southerly therefrom along and in front of Gowanus Bay and Bay Ridge to a point where the said Bay Ridge Channel so to be opened encounters a 21-foot contour or depth of water, so that the channel so to be opened shall be of a uniform depth of 21 feet and width of 400 feet at low water."

The same act calls for an examination of the channel, "with a view of removing the shoal and providing a uniform depth of 23 feet at mean low water opposite the Bay Ridge shore to the 23-foot curve in the New York Harbor."

It is upon this latter special examination that this report is submitted.

It is estimated that the amount available for improvement will complete one-half of the approved project; that is, will open a channel 200 feet wide and 21 feet deep, mean low water, from Twenty-eighth street southward to Sixtieth street. If the project be modified to give 23 feet depth over a channel 400 feet wide, as the act calls for, the quantity of material necessary to be removed, exclusive of the estimates for existing approved depth of 21 feet, is 294,907 cubic yards, measured in scows, allowing one-half foot overdepth and 30 per cent. increase of bulk.

This computation is based upon a survey made by this office in July, 1890.

It will be noticed that provision is made in the act not only for deepening the channel, but also for "removing the shoal * * * opposite the Bay Ridge shore to the 23-foot curve in the New York Harbor."

The shoal referred to lies immediately westward of the Bay Ridge shore, from which it is separated by the Bay Ridge Channel. It is 3 miles long, approximately, and has an average width of 3,600 feet between 23-foot curves. The least depth of water over the shoal is 9 feet mean low water, and the average depth about 17¾ feet mean low water. The quantity of material contained between the 23-foot curves is 10,171,491 cubic yards, scow measurement.

No survey of this shoal has ever been made under the direction of the Engineer Department, but the computations are based upon data furnished by the Coast Survey chart prepared from surveys made in 1885, since which time it is believed no material change has taken place. The estimates for the proposed deepening of Bay Ridge Channel and removing the shoal are summarized as follows, scow measurement:

	Cubic yards.
Deepening Bay Ridge Channel to provide a uniform depth of 23 feet, mean low water	294, 907
Removing shoal opposite Bay Ridge shore to 23 feet, mean low water	10, 171, 491
Total estimate, in addition to estimates for approved project	10, 466, 398

The northern end of Bay Ridge Shoal terminates near Red Hook, and the widest part is immediately west of Gowanus Bay, to which it gives a degree of protection against high seas resulting from westerly and northwesterly storms. The upper bay of New York Harbor at this point is 4 miles wide, and if the shoal be removed the wharf owners on Bay Ridge shore will find their wharves much exposed to westerly seas, and will doubtless ask the Government to provide secure and sheltered berths for vessels at the wharves by the construction of a breakwater along the line of the existing shoal.

The main ship channel at the upper bay enbraced between Jersey Flats and Bay Ridge Shoal is 4,300 feet wide between the 26-foot contours. This width affords ample accommodation for the commerce of the port, and until Jersey Flats are improved and occupied for commercial purposes by artificial and permanent structures located upon or near the outer margin marked by a line joining Robbins Reef, Oyster Island, and Bedloe Island, it would seem wise in an economical view not to enlarge the navigable capacity of the Upper Bay by the removal of the Bay Ridge Shoal. When the necessity arises for greater harbor capacity, it may be gotten by gradually widening the Main Ship Channel to the eastward by excavations made along the western margin of the shoal.

In regard to modifying the existing project for the improvement of the Bay Ridge Channel so as to provide 23 feet depth mean low water, it may be said that the character of the existing commerce of Gowanus Bay is such that every reasonable facility is given for its accommodation by the navigable depth of 21 feet mean low water which the approved project affords, and that, in my opinion, as has been already expressed in a report upon Buttermilk Channel and Gowanus Bay channels, dated October 17, 1890, there is no prospect that any demand for a 23-foot depth mean low water in Gowanus Bay will arise in the near future.

For the foregoing reasons I do not think that the Bay Ridge Channel is "worthy of improvement" at this time to the extent of "removing the shoal and providing a uniform depth of 23 feet at mean low water opposite the Bay Ridge shore to the 23-foot curve in the New York Harbor."

No allotment is recommended to be made for additional surveys.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

E 15.

PRELIMINARY EXAMINATION OF CHAMPLIN'S CREEK, IN TOWN OF ISLIP, NEW YORK.

[Printed in House Ex. Doc. No. 66, Fifty-first Congress, second session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 5, 1890.

SIR: I have the honor to submit herewith the accompanying copy of report dated November 28, 1890, from Lieut. Col. G. L. Gillespie, Corps of Engineers, giving results of preliminary examination of Champlin

Creek, in town of Islip, N. Y., made to comply with provisions of the river and harbor act approved September 19, 1890.

Lieutenant-Colonel Gillespie reports that, as there is no commercial interest involved, he does not think Champlin Creek worthy of improvement, and in this opinion I concur.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. REDFIELD PROCTOR,
Secretary of War.

REPORT OF LIEUTENANT-COLONEL G. L. GILLESPIE, CORPS OF ENGINEERS.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., November 28, 1890.

GENERAL: In compliance with letter of the Chief of Engineers, dated September 20, 1890, I have the honor to submit the following report upon the examination of Champlin Creek, in town of Islip, N. Y., for which provision is made in the river and harbor act approved September 19, 1890.

Champlin Creek is at the eastern end of the town of Islip, on the southern shore of Long Island, New York, and is a tributary of Great South Bay, which it enters about opposite Fire Island Light. There is a dam across the creek, about 1 mile above the mouth, which converts the upper part into a pond used as a fish preserve. The length of the creek from the dam to the mouth is about 1 mile; the depth in the creek proper is about 2 feet, and on the bar across the mouth about 1½ feet at low water. The creek is straight, and there is about 6 feet of water in Great South Bay outside of the bar, about 1,000 feet from the crest.

The town of Islip has, according to the census of 1890, a population of 8,747; it is mainly a place of summer resort, and has no manufacturing or commercial interests. There are about 25 boats, sloops, and catboats, registering from 6 to 10 tons and drawing from 3 to 4 feet of water, that would use the creek for anchorage. These boats are mainly pleasure boats. As the anchorage in the bay is very much exposed and vessels can not lie there with safety in stormy weather, it is desired by the owners of these vessels that the creek and bar be dredged to 4 feet at mean low water, so as to permit them to use the creek for anchorage.

The demand for the improvement is local, and only affects those immediately on the creek, to whom it will be simply a matter of convenience, since there is at the western end of Islip, at Great Cove, a water way with sufficient depth and safe anchorage.

As there is no commercial interest involved and no benefit will accrue to navigation other than providing a more convenient anchorage for pleasure yachts, I do not think Champlin Creek is "worthy of improvement."

No allotment is recommended to be made for a survey with the view to the preparation of estimates for improvement.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

E 16.

PRELIMINARY EXAMINATION OF HUDSON RIVER AT CORNWALL FROM THE MOODNA RIVER, OTHERWISE KNOWN AS MURDERER CREEK, TO THE CHANNEL OR DEEP WATER OF THE HUDSON RIVER, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., October 17, 1890.

GENERAL: In compliance with Department letter of September 20, 1890, I have the honor to submit the following report on the preliminary examination of "Hudson River at Cornwall from the Moodna River, otherwise known as Murderer Creek, New York, to the channel or deep water of the Hudson River," to comply with the provisions of the river and harbor act of September 19, 1890.

Moodna Creek enters the Hudson River at the head of a shoal bay indenting the west shore of the river immediately north of Cornwall Landing.

The West Shore Railroad crosses the bay near its head on a combined earthen embankment and trestle bridge, 2,300 feet long, approximately, which was built in 1884 without a draw opening. This embankment shuts off all communication between the creek and the Hudson River, except such as can be carried on in boats capable of passing between the bays of the trestle bridge, which are spaced at intervals of 15 feet from center to center. The trestle bridge is 350 feet long, and its height is 10 feet, approximately, above low water. The range of tides is 2½ feet.

From the bridge to the deep water of the Hudson, a distance of 2,700 feet, approximately, a channel 40 feet wide and 7 feet deep at low water has been dredged by private parties over a sand shoal where the original depth was uniformly from 4 to 6 feet, mean low water.

From the railroad bridge at the mouth to the turnpike bridge, one-half mile to the westward, the channel is somewhat obscure, and the depth varies from 4 feet to 7 feet, mean low water, except at a shoal where the depth is reduced to 1 to 2 feet, mean low water.

There are three or four old docks on the shores of the bay and creek inside the railroad bridge which have been practically abandoned for several years, but the information gained by an examination by Mr. Charles G. Weir, assistant engineer, a copy of whose report of September 26, 1890, is inclosed herewith, indicates that the creek has a moderate commercial value.

The principal industries are a paper mill and a brickyard, at which 15,000,000 brick, having a value of $75,000, were manufactured during 1889.

The brick shipped from the yard are all carried in wheelbarrows over a light trestle to the barges or schooners which are enabled to come through the dredged channel to within 50 feet of the railroad.

If the bridge were provided with a 40-foot draw, so as to permit vessels to enter the creek with facility, a considerable commerce would doubtless be developed.

I respectfully invite attention to Captain Derby's report on this creek, being second indorsement, December 11, 1888, on letter from Mr. Henry Bacon, Goshen, N. Y., October 22, 1888, complaining that the West Shore Railroad Bridge across the mouth of the creek is an obstruction to its navigation, and petitioning for its removal.

The Secretary of War served a notice upon the New York Central and Hudson River Railroad Company, lessees of the West Shore Rail-

road, February 6, 1889, directing that company to so alter the bridge as to render navigation through or under it free, easy, and unobstructed.

The matter was referred to this office July 6, 1889, with directions to report what steps, if any, had been taken by the New York Central and Hudson River Railroad Company to comply with the requirements of the notice which had been served upon it February 6, 1889. My report in reply thereto was made July 15, 1889, to which I respectfully refer.

The company has since built pile piers for a 40-foot span, and has delivered the necessary iron for the proposed modification, but has practically done nothing to relieve the navigation of the creek.

The foregoing statements in regard to the navigable character of the creek, and to the manner in which its commerce is restrained by the railroad bridge, seem a proper accompaniment to a report on the water way from the mouth of the creek to the deep water of the Hudson River beyond.

It is estimated that a channel 60 feet wide and 8 feet deep (mean low water) will equal all proper demands of the commerce of the creek. Existing charts, which are not of late date, indicate that such an improvement will require the excavation of 25,000 cubic yards of material, which is reported to be of a soft character and of easy removal.

I have the honor to state that I consider the proposed channel "from the Moodna River, otherwise known as Murderer Creek, New York, to the channel or deep water of the Hudson River," to be worthy of improvement, in view of the probable construction of a draw opening in the railroad bridge, and respectfully recommend an allotment of $100, "to make the survey and report contemplated by the act, including a project, with estimate of the cost of the improvement."

I respectfully inclose copy of a letter addressed to me by Mr. Charles H. Wood, postmaster of Cornwall, in relation to the improvement.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. CHARLES G. WEIR, ASSISTANT ENGINEER.

U. S. ENGINEER OFFICE,
Castleton, N. Y., September 26, 1890.

COLONEL: In compliance with your instructions, I have the honor to submit the following report on the preliminary examination of the Moodna River, otherwise known as Murderer Creek, near Cornwall, N. Y., made on September 24.

The Moodna or Murderer Creek enters the Hudson River at the head of a shoal bay indenting the west shore 1¼ miles above the West Shore Railroad depot at Cornwall. The creek is said to extend about 30 miles inland, and drains a considerable area.

The West Shore Railroad crosses the creek at the head of the bay on an earth embankment and trestle. The length of this trestle is 350 feet, and height above high water about 8 feet. The bents are 15 feet apart from center to center. This effectually shuts out all navigation of the creek.

Before the construction of the railroad the creek was navigable for a distance of about ¾ of a mile above the point where the railroad now crosses. At present there is a dredged channel 40 feet wide and 7 feet deep at low water from the deep water of the Hudson River to the railroad, where in the channel of the creek the water is 8 to 10 feet deep.

For a distance of 1,500 feet above the railroad the depth of water in the channel of the creek varies from 4 to 7 feet. At this point a bar exists with not more than a

foot of water over it at low water, and with a narrow channel across it of probably a depth of 2 to 3 feet.

Above this bar for about 2,000 feet the depth of water in the channel of the creek varies from 4 to 7 feet.

There is at present on the creek a paper mill and a brickyard in active operation. There is also a linen mill, but which has not been in operation for 2 years. The paper and linen mills are located about a mile up the creek, the brickyard being located about 300 feet west of and above where the railroad crosses. The product of the paper mill is hauled by teams to Cornwall, and shipped by railroad, though I understand that before the railroad was built both mills shipped their products by vessel direct from the mill to New York. The principal industry on the creek is the manufacture of brick, there being one brickyard owned by C. A. and H. P. Hedges which has a capacity of 25,000,000 brick. The brick manufactured this year will amount to 15,000,000, which, at $5 per thousand, shows a valuation of $75,000. The brick shipped from this yard are all carried in wheelbarrows, over a light trestle, to the barges or schooners, which are enabled to come through the dredged channel to within 50 feet of the railroad.

The railroad practically closing the creek to all navigation, it is my opinion that any improvement of the channel is unnecessary and unwarranted. If, however, a 30-foot draw were put in where the channel of the creek crosses the railroad, to permit vessels to enter the creek, a considerable commerce would be developed, as there are valuable brick properties on the creek.

Prior to 1887 an effort was made to compel the railroad company to so alter the trestle as to render navigation through it free, easy, and unobstructed. The company went so far as to put in pile piers for a 40-foot span, the iron for which is now on the ground. Nothing further was done, and it remains as it was left in 1887.

The honorable the Secretary of War, on February 6, 1889, served a notice on the New York Central and Hudson River Railroad Company, lessee of the West Shore Railroad, via west shore of the Hudson River, to so alter the said bridge as to render navigation through or under it free, easy, and unobstructed, but nothing has been done by the railroad company to comply with these requirements.

Very respectfully, your obedient servant,

CHARLES G. WEIR,
Assistant Engineer.

Lieut. Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

LETTER OF MR. CHAS. H. WOOD, POSTMASTER.

CORNWALL-ON-THE-HUDSON, N. Y.,
September 24, 1890.

SIR: I beg to acknowledge the receipt of your letter of the 23d instant, requesting information regarding the proposed improvement of navigation at this place.

The particular necessity for the proposed improvement is the straightening and deepening of the channel so that vessels, including tugs, schooners, and barges, now navigating between the mouth of the Moodna and deep water of the Hudson River, may do so at all stages of the tide with greater safety and without fear of grounding.

The particular commercial interest to be subserved by the proposed improvement is the brick manufactory located here and the interests of the owners of tugs, schooners, and barges engaged in carrying brick to the markets.

The principal industry at present located on this water is a brickyard with a capacity for turning out 25,000,000 brick a year, almost the entire product of which is sent to market from this point. Boats of tonnage as high as 600 and 700 tons are engaged in this carrying trade.

Lumber and coal are also brought in here, and I believe some other industries are projected. It is rumored that extensive coal docks are to be built, and there is some talk of a gas house or an electric-light plant.

Formerly, before the West Shore Railroad was built (about 1884), vessels were engaged in making regular trips from docks on the Moodna.

I presume your examination at present would be limited to a distance of about 900 yards, that is, between deep water of the Hudson and the West Shore Railroad bridge across the mouth of the Moodna, which at present obstructs further navigation of the latter river, although I am informed that the War Department has already taken steps to compel the railroad company to put in a drawbridge here.

The Moodna River is navigable for a distance of about three-fourths of a mile above this bridge, and there are three old docks above the bridge which were used by boats of from 100 to 500 tons up to the time of the building of this bridge.

The Congressman for this district is Moses D. Stivers, of Middletown, Orange County, N. Y.

I will speak to the Messrs. Hedges, who own the brickyard referred to, about your letter, and they will no doubt furnish you with more information on the subject than I am able to give.

I hope the proposed improvement will be made, as I feel confident that the commercial interests of this place will be thereby enhanced through the development of other industries upon this water way.

Respectfully yours,

CHAS. H. WOOD,
Postmaster.

Lieut. Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

SURVEY OF HUDSON RIVER AT CORNWALL FROM THE MOODNA RIVER, OTHERWISE KNOWN AS MURDERER CREEK, TO THE CHANNEL OR DEEP WATER OF THE HUDSON RIVER, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., August 7, 1891.

GENERAL: In obedience to instructions contained in your letter of October 18, 1890, I have the honor to submit a report on the survey of "Hudson River at Cornwall from the Moodna River, otherwise known as Murderer Creek, to the channel or deep water of the Hudson River," to comply with the requirements of the river and harbor act approved September 19, 1890.

The survey which was assigned to the charge of Mr. Charles G. Weir, assistant engineer, Hudson River improvement, was made in June, 1891, and the results are shown in his report, dated June 26, 1891, copy of which is herewith inclosed.

The preliminary report submitted to the Chief of Engineers October 17, 1890, and the report of Mr. Weir leave but little additional to be said in regard to this unimportant channel. The letter from Mr. Charles H. Wood, postmaster at Cornwall, accompanying my preliminary report on this survey October 17, 1890, states:

> The particular commercial interest to be subserved by the proposed improvement is the brick manufactory located here and the interests of the owners of tugs, schooners, and barges engaged in carrying brick to the markets.
>
> The principal industry at present located on this water is a brickyard with a capacity for turning out 25,000,000 brick a year, almost the entire product of which is sent to market from this point. Boats of tonnage as high as 600 and 700 tons are engaged in this carrying trade.

The channel to which the act refers lies wholly in the Hudson River to the eastward of the West Shore Railroad Bridge across the mouth of Moodna River, and the wharf at which the brick are handled is situated on the south bank of the creek to the westward of said bridge. Vessels going to the creek for the brick lie outside the railroad bridge and receive their cargoes from wheelbarrows which pass over a connecting trestle built underneath the railroad track. The wharves on both banks of the small stream near its mouth, which formerly had a slight commercial value, have now fallen into decay, because vessels can not reach them owing to the shoal depths in the creek, and chiefly to the obstruction to navigation offered by the railroad bridge, which is without a draw opening.

As my preliminary report on this subject, dated October 17, 1890, states that the proposed channel in the "Hudson River at Cornwall from the Moodna River, otherwise known as Murderer Creek, to the channel or deep water of the Hudson River" is "worthy of improvement, in view of the probable construction of a draw opening in the railroad

bridge," it becomes necessary to refer in brief terms to the result of an endeavor since that date on the part of the United States, before the United States district court, southern district of New York, to compel the railroad to so alter said bridge as to render navigation through it "free, easy, and unobstructed."

Mr. Henry Bacon, of Goshen, N. Y., made a complaint to the Secretary of War, October 22, 1888, that the bridge in question was an obstruction to navigation under the river and harbor act of August 11, 1888. The matter was referred to Captain Derby, Corps of Engineers, for examination and report, and a report thereon was submitted by him December 11, 1888, in which he states that he is "of the opinion that the trestle is an obstruction to the free and safe navigation of a navigable stream."

Under sections 9 and 10 of the river and harbor act of August 11, 1888, the Secretary of War served notice, February 6, 1889, upon the New York Central and Hudson River Railroad Company, lessee of the West Shore Railroad, requiring an alteration to be made in the bridge by July 1, 1889, which would render navigation through it "free, easy, and unobstructed."

The railroad company having failed to alter the bridge by September 1, 1890, 14 months after the time fixed by the notice of the Secretary of War had expired, suit for penalty was directed to be instituted by the Attorney-General, at the request of the Secretary of War, and the case came up for trial in the United States circuit court, southern district of New York, January 12 and 13, 1891, before Hon. William J. Wallace, judge, and a jury.

Judge Wallace stated in his charge to the jury that "the question of fact, and the only question of fact" for them to decide was "whether the trestle work or bridge maintained by the defendant was an obstruction to the free navigation of any navigable waterway of the United States," and further defined a "navigable waterway" to be "not every stream which will float a canoe, nor any stream necessarily that is capable of being used to float a vessel of any kind," but "one adapted for the transportation of the trade and commerce of the neighborhood."

The verdict which was rendered by the jury was in favor of the railroad company, and no appeal was taken by the United States. The effect of this verdict is that Murderer Creek is not a navigable waterway of the United States.

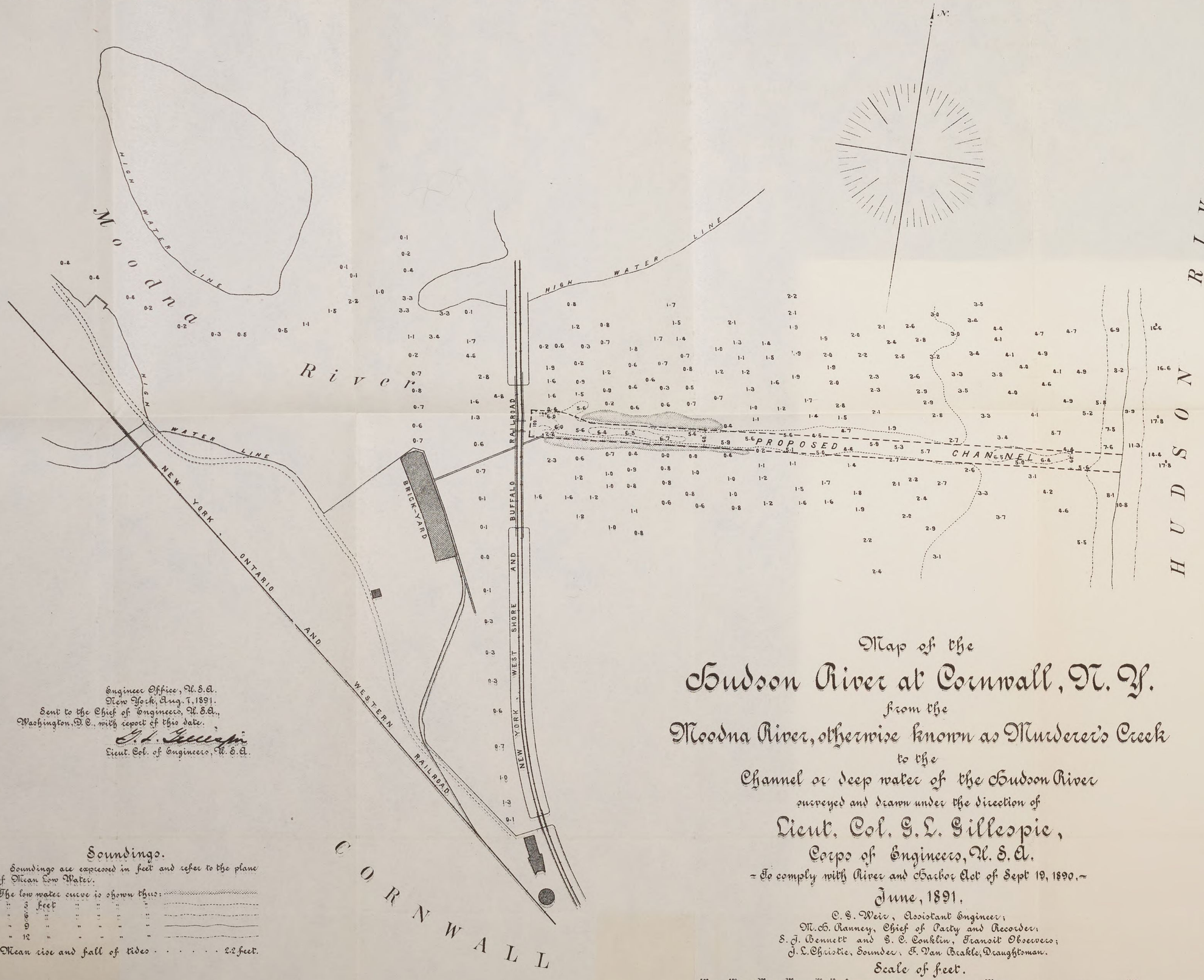
It is estimated that the formation of a channel 60 feet wide and 9 feet deep, mean low water, from the bridge to the deep water of the Hudson River will require the excavation of 35,000 cubic yards of material, at an estimated cost of $10,000, but inasmuch as it has been decided that Moodna River is not a navigable stream, I do not feel authorized to recommend that an appropriation be made for the improvement of the channel in the "Hudson River at Cornwall from the Moodna River, otherwise known as Murderer Creek, to the channel or deep water of the Hudson River," for the survey of which provision is contained in the river and harbor act of September 19, 1890.

Moodna River is in the collection district of New York City, which is the nearest port of entry. The nearest fort is Fort Columbus, Governor Island, New York Harbor. The nearest light-house is at West Point, N. Y.

Very respectfully your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.



Engineer Office, U.S.A.
New York, Aug. 7, 1891.
Sent to the Chief of Engineers, U.S.A.,
Washington, D.C., with report of this date.

G. L. Gillespie
Lieut. Col. of Engineers, U.S.A.

Soundings.

Soundings are expressed in feet and refer to the plane of Mean Low Water.

The low water curve is shown thus: .....

" 3 feet " " " " -----

" 6 " " " " " -----

" 9 " " " " " -----

" 12 " " " " " -----

Mean rise and fall of tides . . . . . 2.2 feet.

Map of the Hudson River at Cornwall, N. Y.

from the

Moodna River, otherwise known as Murderer's Creek

to the

Channel or deep water of the Hudson River

surveyed and drawn under the direction of

Lieut. Col. G. L. Gillespie,

Corps of Engineers, U. S. A.

- To comply with River and Harbor Act of Sept 19, 1890. -

June, 1891.

C. S. Weir, Assistant Engineer;
M. H. Ranney, Chief of Party and Recorder;
S. J. Bennett and S. C. Conklin, Transit Observers;
J. L. Christie, Sounder, F. Van Brakle, Draughtsman.

Scale of feet.

500 400 300 200 100 50 0 500 1000

Eng 91

REPORT OF MR. CHARLES G. WEIR, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Albany, N. Y., June 26, 1891.

COLONEL: I have the honor to submit the following report upon the survey of the Hudson River at Cornwall, N. Y., from the Moodna River, otherwise known as Murderer Creek, to the channel or deep water of Hudson River.

The Moodna River enters the Hudson at the head of a shoal bay on the west shore, at a point 1¼ miles north of the steamboat landing at Cornwall, N. Y., and 54 miles above the city of New York.

Formerly the river (so called) was navigable for a distance of 1¼ miles above its mouth, but only for light-draft boats. By the construction of the West Shore Railroad, which crosses the creek on an embankment and trestle at its mouth, no vessels can enter, as the height of the trestle is only 8 feet above high water, and the width between bents is only 15 feet.

The commerce of the creek consists entirely of the shipments of brick from the yard of C. A. & H. P. Hedges, which is situated about 300 feet west of the railroad crossing. During the present season they will ship 8,000,000 brick, which, at $5 per 1,000, has a value of $40,000. These brick are wheeled over a light trestle under the railroad track to the schooners and barges on which they are shipped. To enable boats to get into the small dock near the railroad crossing a channel was dredged by Mr. Hedges from the deep water of the Hudson, 2,100 feet long, 40 feet wide, and 6 feet deep, during the season of 1888 and 1889. This channel exists in part to-day, as will be seen on the accompanying map, but is constantly shoaling, as the material when dredged was merely thrown and banked up on either side. The draft of vessels (schooners and barges) used in shipping brick varies from 6 to 8 feet, and the present channel is not sufficiently wide or deep to accommodate them at all tides, the rise and fall of tides being only 2.2 feet.

To give proper accommodation a channel 60 feet wide and 9 feet deep, with a basin 100 feet square near the dock, should be dredged out. The distance to deep water in the Hudson being 2,100 feet, the amount of material required to be removed would be 35,000 cubic yards, which, at 25 cents per yard, would amount to $8,750, and for contingencies, about 15 per cent., would make a total cost of $10,000.

This part of the river is in the collection district of New York City, which is the nearest port of entry.

Respectfully submitted.

CHARLES G. WEIR,
Assistant Engineer.

Lieut. Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

E 17.

PRELIMINARY EXAMINATION OF BRONX RIVER, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., December 1, 1890.

GENERAL: In obedience to letter of the Chief of Engineers, dated September 20, 1890, I have the honor to submit the following report upon the examination of Bronx River, New York, for which provision is made in the river and harbor act approved September 19, 1890.

Bronx River is a small stream which rises in the northern part of Westchester County, N. Y., flows southerly in a direction generally parallel to the Hudson River, from which it is distant 3 miles at the nearest point, and finally empties into the East River, between Hunt and Clauson Points, 2½ miles eastward from Port Morris.

Through the estuary into which it empties it has a shallow and tortuous channel 1 mile long, which is obstructed by shoals varying in depth from 2.7 to 3 feet, mean low water. The mean range of tides at the entrance is 6.5 feet. From the head of the estuary to the Westchester road the least depth is about 5 feet, mean low water, and

thence to the dam at West Farms the depth gradually diminishes to zero.

A survey of Bronx River was made in 1880, to comply with the provisions of the river and harbor act approved June 14, 1880. The report, accompanied with estimates, which will be found on page 665, Annual Report Chief of Engineers for 1881, states that the improvements most needed at that time are confined to the reach of the river which extends from the head of tide water at West Farms downstream to a point 1,600 feet below the Westchester Road Bridge, and the estimated cost for a channel 30 feet wide and 4 feet deep, mean low water, was given at $42,000.

Since the date of the survey one new dock has been built on the river. It is believed that the hydrographic conditions have not materially changed during this interval.

Since the tracks of the Harlem Railroad were sunken between Mott Haven, and Williamsbridge, N. Y., immediately north of the Harlem River, there has been no station between these points for the receipt and shipment of local freight, and in consequence supplies designed for the Twenty-third and Twenty-fourth wards, New York city, lying north of One hundred and seventieth street and east of the Harlem Railroad, have been delivered in part by the Bronx River. There are many dams across the stream, which have been built for various industrial purposes and which it is not expedient to remove to facilitate commerce, if such a design were in contemplation. The last dam in the river is at West Farms. The river may properly be improved to that point so as to provide for the delivery of such supplies as building stone, lime, cement, coal, and lumber as may be required for the adjacent towns of West Farms, Bronx, Belmont, and Bronxdale.

I am informed that all the face stone needed for the Harlem Railway improvement above One hundred and seventieth street, and a great quantity of broken stone for road-making under the city government, were delivered by the Bronx River.

The tonnage carried by the Bronx River during the fiscal year ending June 30, 1890, was 250,000 tons, approximately, with an estimated valuation of $1,000,000, and was carried in lighters and canal boats whose draft was from 5 to 6 feet.

I inclose herewith a copy of a letter received at this office in regard to existing obstructions in the river and to the relief which will be given by their removal, to the towns in and tributary to the valley. I regard the river "worthy of improvement" from a point 1,600 feet below Westchester Road Bridge to the head of navigation at West Farms, and recommend that the improvement be limited to deepening the river and removing rocky obstructions.

I respectfully recommend that an allotment of $500 be made to enable this office to make a new survey of the river between the limits designated, and to prepare the necessary estimates of cost of improvement.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

LETTER OF MR. D. MAPES, JR.,

NEW YORK, *October, 1890.*

DEAR SIR: In compliance with a request in your letter to Church E. Gates & Co., would say that the Bronx River is the only water route for that part of the Twenty-third and Twenty-fourth wards lying north of One hundred and seventieth street and east of the Harlem Railroad. A proof of this is the fact that the contractors who sunk the Harlem Railroad track had all their face stones that were needed above One hundred and seventieth street landed on the Bronx River. Also the city department of public works had some 19,000 yards of macadamizing stones landed here, some of which were sent as far west as Washington avenue, in Tremont, and northward. Besides these there has been a considerable quantity of stones sent from here, in the town of West Chester.

This, togther with the business already here, including the Bronx Bleaching and Dyeing Company and the Bronx Tape Company, who use a great deal of coal, Mr. Woolf's flour mill for grain, three coal yards, three lumber yards, one stone yard, and three feed stores, all depending on the Bronx for their supplies, as well as the coal for a number of schools and also for the fire department in this vicinity, makes the Bronx very important.

The present condition of the river makes it very troublesome and expensive to get boats in, as they can only be got in at the high tide, and if by any chance they are delayed a very short time, must wait for another tide, and, sometimes when the tides are poor, must wait for a number of days for a change of wind, so as to get a full tide.

As this vicinity is now beginning to grow rapidly and will need more material each year, it will be found quite necessary to have the Bronx improved by taking out some bad rocks, deepening, and straightening the channel.

D. MAPES, JR.

Lieut. Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

SURVEY OF BRONX RIVER, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., August 25, 1891.

GENERAL: In obedience to instructions contained in your letter of December 3, 1890, I have the honor to submit a report, with chart,* of Bronx River, New York, made to comply with the requirements of the river and harbor act approved September 19, 1890.

The preliminary report, submitted on December 1, 1890, which gives the general characteristics of the river and the tonnage of the commerce it carries, limited the recommendation for the survey to that part of the river which extends from West Farms to a point 1,600 feet below Westchester Road Bridge. It will only be necessary to supplement that report by the estimates of cost of a project for widening and deepening the existing channel in the river so as to afford a navigable channel 4 feet deep at mean low water and 100 feet wide, from the head of the estuary at Strain Place to Barlow street; 60 feet wide to Dongan street and 50 feet wide to West Farms, below the Bronx Company's dye works, a total distance of $1\frac{3}{4}$ miles from the estuary. Rock, where an obstruction to navigation, is found chiefly between the gas works and Dongan street; above this reach the bed is composed of hard material consisting of compact gravel; below Dongan street the material of the bed is less compact and is composed of sand and mud. Through the estuary, seven-eighths of a mile, to the margin of the East River, the bed is composed of fine sand through which there is no defined channel. The estuary measures about 1 square mile, and the depth of water over it at mean low stage varies from 3 feet to 6 feet.

The best approach to the entrance to the river is along the western

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*Not printed.

margin of the estuary, where the least depth is 4 feet mean low water. The bridges of the Westchester road and of the Harlem and Port Chester Railroad both have single draw openings 40 feet wide in the clear.

The cost of making a navigable channel 4 feet deep, mean low water, from the entrance to West Farms is estimated as follows:

Dredging channel from Strain Place to Barlow street, 100 feet wide and 4 feet deep, mean low water; 16,000 cubic yards of material, in place, at 25 cents	$4,000
Dredging channel from Barlow street to Dongan street, 60 feet wide and 4 feet deep, mean low water; 10,000 cubic yards of material, in place, at 25 cents	2,500
Dredging channel from Dongan street to head of navigation at West Farms 50 feet wide and 4 feet deep, mean low water; 28,880 cubic yards of material, in place, at 25 cents	7,220
Drilling, blasting, and removing 4,070 cubic yards of rock, at $15	61,050
	74,770
Engineering and contingencies, 15 per cent	11,215
Total	85,985

No estimate is submitted for dredging a channel across the estuary, as it is believed that no dredged channel can be maintained there without the assistance of artificial works of contraction constructed at an estimated cost of not less than $100,000. The existing commerce of the river does not seem to justify the expenditure of such a sum at this time. For this reason the estimates herein submitted are for a project which contemplates carrying the navigable depth now found at the entrance up to West Farms, in a water way whose width varies with the existing width between the banks, and clearing the bed of all bowlders or rocks which may be found embedded in it above the plane of 6 feet, mean low water.

The mean range of tides at West Farms is 5.87 feet, and at the estuary, 6.57 feet.

This report is accompanied by a report of Mr. G. W. Kuehnle, assistant engineer, under whose direction the survey was made, to which I respectfully invite attention for the details of the survey.

COMMERCIAL STATISTICS.

Neither the tonnage of the river nor the facilities for handling it have been increased since the preliminary examination, October, 1890, at which time the following statistics were obtained:

Commercial statistics Bronx River, New York, for the fiscal year ending June 30, 1890.

Articles.	Tons.	Value.
Coal	50,000	$200,000
Grain	2,250	75,000
Lumber	10,000	200,000
Stone	100,000	310,000
Gas pipe	50,000	400,000
Miscellaneous	9,000	90,000
Total	221,250	1,275,000

Character and draft of vessels.

Class.	Number.	Tonnage.	Draft.
			Feet.
Canal boats	200	20,000	6
Lighters	33	1,650	5

The Bronx River is in the collection district of New York. The nearest port of entry is New York City. The nearest light-house is North Brother Island Light on North Brother Island, East River. The nearest fort is Fort Schuyler.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. G. W. KEUHNLE, ASSISTANT ENGINEER.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., August 21, 1891.

SIR: I have the honor to submit the following report on the survey of Bronx River, New York, made by your order of December 5, 1890, in compliance with the requirement of river and harbor act of September 19, 1890.

The survey was made during April and May, 1891, by the hydrographic party, in charge of Mr. John Johnstone, surveyor, under directions from this office, and extends from the dam at West Farms to Gilbert street, below the Westchester road bridge. It was made in the usual manner, the soundings being located by means of transits on established triangulation stations, and reduced to the plane of mean low water, determined in 1880.

There is no change in depth or condition from the results obtained by the survey of 1880, and the shore line is the same, except that one new dock (Church E. Gates & Co.) has been built since that date. That portion of the map accompanying this report below Gilbert street was copied from the survey of 1880.

The Bronx River is crossed at the Westchester road by an iron bridge with a single draw opening 45 feet in width, operated by hand power, and at the crossing of the Harlem River Branch of the New York, New Haven and Hartford Railroad by a double-track wooden bridge, with a single draw opening 40 feet in width, operated by hand power. The material from the head of navigation to the Westchester Road Bridge is sand and gravel, with a slight covering of mud; below the bridge the material is sand and mud. Between the gas works and a point about 1,800 feet below the Westchester Road Bridge numerous ledges of rock are found, mainly on the east side of the river, and two extending entirely across the channel.

The following estimate is based on a project which provides for a channel 4 feet deep at mean low water and 100 feet wide from Strain Place to Barlow street, thence 60 feet wide to Dongan street, and thence 50 feet wide to the head of navigation about 1,100 feet below the dam, including the removal of rock to a depth of 6 feet, mean low water. As the mean rise and fall of the tide is over 6 feet, this will afford a navigable depth of 10 feet at high water.

ESTIMATE.

Dredging a channel 100 feet wide and 4 feet deep, mean low water, from Strain Place to Barlow street; 16,000 cubic yards of material in place, at 25 cents	$4,000
Dredging a channel 60 feet wide and 4 feet deep, mean low water, from Barlow street to Dongan street; 10,000 cubic yards of material in place, at 25 cents	2,500
Dredging a channel 50 feet wide and 4 feet deep, mean low water, from Dongan street to the head of navigation at West Farms; 28,880 cubic yards of material in place, at 25 cents	7,220
Drilling, blasting, and removing 4,070 cubic yards of rock, at $15	61,050
	74,770
Engineering and contingencies, 15 per cent	11,215
Total	85,985

Very respectfully, your obedient servant,

G. W. KUEHNLE,
Assistant Engineer.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

E 18.

PRELIMINARY EXAMINATION OF WESTCHESTER CREEK, WESTCHESTER AND NEW YORK COUNTIES, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., December 29, 1890.

GENERAL: In compliance with letter of the Chief of Engineers, dated September 20, 1890, I have the honor to submit the following report in regard to the preliminary examination of "Westchester Creek, Westchester and New York Counties," to comply with the provisions of the river and harbor act of September 19, 1890:

Westchester Creek is a tidal stream emptying into the East River between Clauson Point and Old Ferry Point, about 2½ miles west of Throg Neck. It is navigable at low stage for vessels drawing 4 to 5 feet to the town of West Chester, 2½ miles from the mouth, at which point navigation is obstructed by a low, solid bridge or causeway which has no draw.

At the southern boulevard crossing, in the town of Unionport, 1 mile below West Chester, the iron bridge has a draw of ample width for easy passage of vessels.

The estuary at the mouth into which the creek empties is one-half mile wide between east and west headlands, and the distance between the 8-foot curves on opposite sides of the bar at the mouth is 1,000 feet, approximately, the least depth on the bar being 3½ to 4 feet, approximately.

The creek is divided into comparatively easy and regular reaches, and has thoroughout from West Chester to the mouth a least width between banks of 125 feet, and a general depth of 4 to 5 feet, mean low water. The greatest depth of the channel through the estuary is 11 feet, approximately. The range of tides is 7 feet, approximately.

At two points just below Unionport the stream is said to be obstructed by what is supposed to be rock in place or loose bowlders of small extent.

The promoters of the survey desire a channel 50 feet wide and 8 feet deep, mean low water, from West Chester to the East River, so that vessels suitable for transporting the commerce of the river may enter at all stages of the tide. When such an improvement is effected it is claimed that a daily line of freight steamers will be formed to ply between New York City and West Chester. The navigation at present can only be carried on at high water, and no regular time can be fixed for entering the creek. There are wharves at West Chester and at Unionport for convenient handling of freight. This creek bounds on the eastward the stretch of country, suburban to New York City, which is undergoing constant and rapid improvement and development by the expansion of New York City beyond the Harlem River, and will be extensively used in the near future for transporting building materials, stone, brick, lime, and lumber, hardware, grain, and home supplies, which can not be transported conveniently by rail. The population of the district bordering on the creek is 6,000, approximately.

Obstructed as the stream is, the commerce for the past year was 50,000 tons, having a valuation of $242,000, and was carried in canal boats, scows, and lighters, drawing 5 to 8 feet.

No survey of the creek has ever been made by any branch of the Government.

A personal examination of the creek has been made.

In view of the moderate demands of the people, the probable small cost of the improvement, estimated at not to exceed $25,000, and the rapid development of the country adjacent to the creek, I have the honor to state that, in my judgment, Westchester Creek is "worthy of improvement" from West Chester to the East River.

I respectfully recommend an allotment of $500 to make a survey between the points named preparatory to the formation of plans, with estimates of cost of improvement, which shall provide for the removal of rocks in the creek and for dredging the creek and the bar at the entrance for a navigable water way 60 feet wide and 8 feet deep, mean low water.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

Commercial statistics for Westchester Creek, New York, for the fiscal year ending June 30, 1890.

Articles.	Quantity.	Value.
Coal ..... tons	8,000	$35,000
Brick	5,000,000	30,000
Lumber ..... feet	4,000,000	20,000
Stone ..... tons	10,000	10,000
Sand ..... do	15,000	9,000
Cement ..... barrels	5,000	5,000
Lime ..... do	10,000	5,000
Shingles ..... bundles	146,000	10,000
Locust posts	6,000	6,000
Soda ash ..... tons	1,400	42,000
Bicarbonate of soda (export) ..... do	1,000	70,000
		242,000

Character and draft of vessels.

Class.	Number.	Draft.
		Feet.
Canal boats	100	8
Scows	150	7
Lighters	50	5

SURVEY OF WESTCHESTER CREEK, WESTCHESTER AND NEW YORK COUNTIES, NEW YORK.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., September 8, 1891.

GENERAL: In compliance with letter of the Chief of Engineers, dated December 30, 1890, I have the honor to submit a report with chart on survey of Westchester Creek, New York, made to comply with the requirements of the river and harbor act approved September 19, 1890.

The accompanying chart * confirms in general the statements contained in the preliminary report, dated December 29, 1890, in regard to

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* Not printed.

the width of the channel, the depths of water in the creek and over the bar, and to the existing obstructions to navigation.

From the East River to near the center of the estuary, into which the creek enters, the depth of water at mean low stage is 4 feet, approximately; thence to Eastern Boulevard Bridge, at Unionport, the creek is navigable at low stage for vessels drawing 6½ feet; and thence to West Chester for vessels drawing 3½ feet.

The range of tides at the head of the estuary is 7.10 feet, and at West Chester, 7.11 feet.

The material composing the bed of the creek is generally of mud and sand, and that of the bar of sand alone, which may be readily removed by the usual methods. No rock appears in the water way above the plane of 9 feet below mean low water, except at one point near the mouth of the creek, where it rises to 4.6 feet below that plane.

The highway bridge at the Eastern Boulevard, Unionport, has a sufficient draw opening 50 feet wide, properly located in relation to the deep-water channel.

The survey was made in May and June, 1891, under the supervision of Mr. G. W. Kuehnle, assistant engineer, to whose accompanying report attention is respectfully invited for details of the methods by which the survey was made.

The rock by the survey lies so far below the adopted plan of improvement, or is so distant from the axis of the proposed channel, that no estimate for the removal of any of this class of obstruction is submitted.

The long pools existing in the lower creek, and also in the northern half of the channel through the estuary, seem to indicate that if a channel of the proposed width and depth be excavated across the estuary, uniting Westchester Creek with the East River, it will be maintained with reasonable certainty by tidal agencies for a considerable period of time without requiring the construction of permanent works of improvement to confine the channel across the estuary. No permanent works, therefore, for leading the improved channel across the estuary are outlined or estimated for.

The cost of making a navigable channel 100 feet wide and 8 feet deep at mean low water across the estuary, thence 80 feet wide and 8 feet deep at mean low water to a point about 1,000 feet above Scriven's Dock, and thence 60 feet wide and 8 feet deep, mean low water, to the head of navigation, is estimated as follows:

Dredging a channel 100 feet wide, 8 feet deep at mean low water, and 1,200 feet long across the bar at the entrance to the estuary; 19,000 cubic yards, scow measurement, at 25 cents	$4,750
Dredging a channel 80 feet wide and 8 feet deep, mean low water, from the northern end of deep pool in the estuary to a point 1,000 feet above Scriven Dock; 11,500 cubic yards, scow measurement, at 25 cents	2,875
Dredging a channel 60 feet wide and 8 feet deep, mean low water, to the head of navigation; 69,500 cubic yards, scow measurement, at 25 cents	17,375
	25,000
Engineering and contingencies, 10 per cent	2,500
Total	27,500

COMMERCIAL STATISTICS.

The commerce of the creek is now carried in canal-boats, scows, and small lighters, which draw not less than 5 feet nor more than 8 feet. The number of boats of all classes engaged in the traffic is 300, and the tonnage carried during the year 1890, which has not materially changed during the year 1891, was 50,000 tons, and had an estimated money valuation of $242,000.

The wharf facilities for handling the commerce of the creek is the same as extended in 1890.

Westchester Creek is in the collection district of New York. The nearest port of entry is New York City. The nearest light-house is Throg Neck Light. The nearest fort is Fort Schuyler.

Very respectfully, your obedient servant,

G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

REPORT OF MR. G. W. KUEHNLE, ASSISTANT ENGINEER.

ENGINEER OFFICE, U. S. ARMY,
New York, N. Y., September 7, 1891.

SIR: I have the honor to submit the following report on the survey of West chester Creek, New York, made by your order of January 2, 1891, in compliance with the requirements of river and harbor act of September 19, 1890.

The survey was made in May and June, 1891, by the surveying party in charge of Mr. John Johnstone, surveyor, under directions from this office, and extends from the head of navigation at West Chester to deep water in the East River. A base line was measured near West Chester, and from this a series of triangles was extended over the area of survey. On Clauson Point a check base was measured for verification of the triangulation. From the trigonometrical points established by the triangulation the shore line and soundings were located by intersection of angles observed by means of transits. The soundings were taken with a sounding pole, divided into feet and tenths, and were reduced to the plane of mean low water as established by observations taken during the course of the survey.

Tide gauges were set up at three points on the creek, one on Tiers Dock, at West-Chester; one on the draw-guard of the bridge at Unionport; and one at Scriven Dock, near the head of the estuary. These gauges were carefully leveled in to permanent bench marks, and were connected with two lines of levels. Observations were made at all three of the gauges simultaneously during one lunation, two tides being taken each day. From these observations the plane of mean low water was reduced for each gauge, and the mean rise and fall and other data were obtained. The result of the tidal observations and the slope, as determined by the levels, is shown in tabular form on the accompanying chart.

The entrance to the creek from deep water in the East River is obstructed by a bar 1,200 feet long, across which a depth of approximately 4 feet mean low water can be carried; thence to the Eastern Boulevard Bridge at Unionport there is a navigable channel 6½ feet deep at mean low water; and thence to the head of navigation a channel with a depth of 3½ feet at mean low water.

The material composing the bed of the creek is mud, and the bar across the estuary is fine sand. No rock was found that will require removal under the proposed plan of improvement.

The creek is crossed at Unionport by an iron road bridge with two draw openings 50 feet in width in the clear and operated by hand power.

The proposed improvement on which the following estimate is based provides for a channel 100 feet wide, 8 feet deep at mean low water, and 1,200 feet long across the bar at the entrance; thence following the deep pool, 80 feet wide and 8 feet deep to the deep pool, about 1,000 feet above Scriven Dock; thence 60 feet wide and 8 feet deep to the town of West Chester.

ESTIMATE.

Dredging a channel 100 feet wide, 8 feet deep at mean low water, and 1,200 feet long, across the bar at the entrance to the estuary; 19,000 cubic yards, scow measurement, at 25 cents	$4,750
Dredging a channel 80 feet wide and 8 feet deep, mean low water, from the northern end of deep pool in the estuary to a point 1,000 feet above Scriven Dock; 11,000 cubic yards, scow measurement, at 25 cents	2,875
Dredging a channel 60 feet wide and 8 feet deep, mean low water, to the head of navigation; 69,500 cubic yards, scow measurement, at 25 cents	17,375
	25,000
Engineering and contingencies, 10 per cent	2,500
Total	27,500

Respectfully submitted.

G. W. KUEHNLE,
Assistant Engineer.

Col. G. L. GILLESPIE,
Corps of Engineers, U. S. A.

E 19.

ESTABLISHMENT OF HARBOR LINES IN NEW YORK HARBOR AND ITS ADJACENT WATERS.

a. HARBOR LINES FOR EAST SIDE OF MANHATTAN ISLAND FROM EAST EIGHTY-FIRST STREET NORTH TO THIRD AVENUE BRIDGE; WEST SIDE OF MANHATTAN ISLAND FROM WEST EIGHTY-FIRST STREET NORTH TO SPUYTEN DUYVIL CREEK; WEST BANK OF NORTH RIVER FROM GUTTENBERG, NEW JERSEY, NORTH TO BLOOMER'S, NEW JERSEY; SPUYTEN DUYVIL CREEK THROUGH THE HARLEM RIVER TO THIRD AVENUE BRIDGE; NORTH SHORE OF BRONX KILLS FROM THIRD AVENUE BRIDGE EASTWARD TO BUNGAY STREET (PORT MORRIS), AND BLACKWELL, WARD, AND RANDALL ISLANDS, AND SUNKEN MEADOW.

HARBOR LINE BOARD,
New York City, September 17, 1890.

GENERAL: The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, to comply with section 12 of the river and harbor act of August 11, 1888, has the honor to recommend for adoption harbor lines for the east side of Manhattan Island, from East Eighty-first street north to Third Avenue Bridge; for the west side of Manhattan Island from West Eighty-first street north to Spuyten Duyvil Creek; for the west bank of North River from Guttenberg, N. J., north to Bloomer's, N. J.; for Spuyten Duyvil Creek through the Harlem River to Third Avenue Bridge; for the north shore of Bronx Kills from Third Avenue Bridge eastward to Bungay street (Port Morris), and for Blackwell, Ward, and Randall Islands, and Sunken Meadow.

The recommended lines conform in general to the existing legal lines, and the Board has made changes only where the lines were unnecessarily irregular or where it seemed advisable to give relief or protection to particular sections of the river by pushing the lines outwards or drawing them in.

The principal changes may be noted as follows:

(1) *Manhattan Island, north of Eighty-first street, west side.*—Between One hundred and twenty-first and One hundred and sixty-first streets, the pierhead line is pushed outwards by substituting a straight line for the existing broken line established in 1868. The bulkhead line at Eighty-eighth street was pushed outwards 80 feet approximately (so as to place it at a distance of 220 feet from the west rail of the railroad at that point), and its turning point opposite Eighty-eighth street is connected by straight lines with the legal bulkhead lines at Eighty-first street and at the second turning point south of One hundred and thirtieth street; and a straight bulkhead line from the turning point south of One hundred and thirty-eighth street to the turning point at One hundred and fifty-fifth street is substituted for the existing broken line, between the same points, established in 1868.

(2) *North River, west bank.*—From Tillietudlum Pier, Pleasant Valley Landing, the pierhead line is drawn in nearer to the shore and runs northward in a straight line, following the line established in 1865 for the "exterior line for solid filling," to a point 55 feet outside the stone monument on the pier near the John Pettigrew quarries, and the bulkhead line is made a straight line parallel to the pierhead line and 300

feet distant, terminating near the base of the Fort Lee pier north. And from the John Pettigrew pier north to Bloomer's, the joint pierhead and bulkhead line conforms to the line established by the riparian commission of New Jersey as "an exterior line of solid filling" in 1865.

These changes are made to better preserve the river channel on the approach to the gorge at Fort Washington.

(3) *From the mouth of Spuyten Duyvil Creek to High Bridge* the pier and bulkhead lines coincide and follow throughout the United States limiting lines of improvement, except that abreast of Johnson's foundry they follow on the south shore the modified lines approved by the Engineer Department.

Between High Bridge and Second Avenue Bridge the pierhead lines follow United States limiting lines for improvement; the bulkhead lines coincide therewith, except as follows: On the east bank, from near Wolf street to the bridge of the New York City and Northern Railway, the bulkhead line is drawn 200 feet in rear of the pierhead line and parallel to it, and the piers may be made solid. The width on the front occupied by the slips shall measure not less than one-half of that of the piers. On the west bank, from the foot of One hundred and sixty-fourth street extended to the New York City and Northern Railway Bridge, the same system governs the bulkhead lines and the pier constructions; the same is the case from Macomb Dam Bridge to One hundred and thirty-eighth street on the east bank and to One hundred and thirty-sixth street on the west bank.

These latter provisions are made to provide berths for vessels outside the navigable channel, which might otherwise be injuriously obstructed.

The recommended lines are delineated upon an accompanying chart.* The bulkhead line defines the limit of solid filling; the pierhead line the limit to which open piled structures may be built, except in the case of Harlem River, where the piers between the two lines may be made solid.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
WM. P. CRAIGHILL,
Colonel of Engineers.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieut. Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 15, 1890.

Respectfully submitted to the Secretary of War.

The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, recommends for the approval of the Secretary of War the following harbor lines, described in the within report and delineated upon the accompanying chart:

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*Omitted.

East side of Manhattan Island, from East Eighty-first street north to Third Avenue Bridge;

West side of Manhattan Island, from West Eighty-first street north to Spuyten Duyvil Creek;

West Bank of North River, from Guttenberg, N. J., north to Bloomer, N. J.;

Spuyten Duyvil Creek, through the Harlem River to Third Avenue Bridge;

North shore of Bronx Kills, from Third Avenue Bridge, eastward to Bungay street (Port Morris); and for

Blackwell, Ward, and Randall Islands and the Sunken Meadow.

It is recommended that the lines selected be approved, and that the Secretary place his approval both upon the report and the tracing submitted.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT,
October 18, 1890.

Approved.

L. A. GRANT,
Assistant Secretary of War.

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b. HARBOR LINES FOR RARITAN RIVER FROM CRAB ISLAND TO HEAD OF NAVIGATION AT NEW BRUNSWICK, NEW JERSEY.

HARBOR LINE BOARD,
New York City, October 21, 1890.

GENERAL: The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, to comply with section 12 of the river and harbor act of August 11, 1888, has the honor to recommend for approval and adoption harbor lines for the Raritan River from Crab Island to the head of navigation at New Brunswick, N. J.

The riparian commissioners of New Jersey have never established harbor lines on this river above Marshy Point on the south shore or above Keasbys Dock on the north shore.

It is not practicable to describe precisely by courses and distances the lines herein recommended for approval and adoption, as there are no permanent monuments along the banks to which the different points of the lines can be readily referred. It suffices to say that the pierhead and bulkhead lines coincide throughout this whole reach, follow closely the natural banks, join the heads of all existing wharves built along the stream, and embrace between them a water way which has nowhere a less width than 375 feet.

The relations of the lines which are recommended for approval to the banks of the river are clearly delineated upon the accompanying chart,* which has been corrected to date, and presents a faithful exhibit of all existing structures.

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*Omitted.

This report completes the system of harbor lines necessary to be established on the Raritan River.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
C. B. COMSTOCK,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieut. Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
October 30, 1890.

Respectfully submitted to the Secretary of War.

The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, recommends for the approval of the Secretary of War harbor lines for the Raritan River from Crab Island to the head of navigation at New Brunswick, N. J., described in the within report and delineated upon the accompanying chart.

It is recommended that the lines selected be approved, and that the Secretary place his approval both upon the report and the tracing submitted.

This report completes the system of harbor lines necessary for the Raritan River.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT,
November 3, 1890.

Approved as recommended by the Chief of Engineers.

L. A. GRANT,
Acting Secretary of War.

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c. HARBOR LINES FOR NEWTOWN CREEK, NEW YORK, BETWEEN TERMINALS AT WHALE CREEK AND DUTCH KILLS, ESTABLISHED BY THE SECRETARY OF WAR FEBRUARY 8, 1890, AND METROPOLITAN AVENUE, THE PRESENT HEAD OF NAVIGATION OF THE CREEK.

HARBOR LINE BOARD,
New York, N. Y., December 16, 1890.

GENERAL: The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters, Corps of Engineers, October 5, 1888, to comply with section 12 of the river and harbor act of August 11, 1888, has the honor to recommend for adoption harbor lines for Newtown Creek, New York, between the terminals at Whale Creek and Dutch Kills, established by the Secre-

tary of War February 8, 1890, and Metropolitan Avenue, the present head of navigation of the creek.

In this connection attention is respectfully invited to section 5 of report of the Board dated January 27, 1890, in relation to the lines from the mouth of Whale Creek to the East River.

From the mouth of Whale Creek eastward to Penny Bridge, at Meeker avenue crossing, the recommended lines conform to the legal lines established April 17, 1857, by chapter 763, Laws of State of New York, 1857; and from Penny Bridge to Metropolitan avenue conform to those established April 20, 1870, by chapter 428, Laws of State of New York, 1870.

It is not practicable to describe by precise courses and distances the lines herein recommended for approval and adoption, as there are no permanent legal monuments along the banks to which the different points of the lines may be referred by coördinates or offsets. It suffices to say that the pierhead and bulkhead lines coincide throughout and follow closely the outer lines of existing bulkheads which have been erected under State authority to confine and protect the water fronts of riparian owners along the stream, or, in the absence of such bulkheads, follow closely the natural banks, and maintain between them the legal widths of channel adopted by the State acts.

From Whale Creek to the foot of Mussel Island the width of the stream between the recommended harbor lines is in general 220–250 feet, and thence to Metropolitan avenue the width is nowhere less than 160 feet.

The relations of the lines, which are recommended for approval, to the two banks are clearly delineated upon the accompanying chart, which has been corrected by recent surveys and presents a faithful exhibit of the two banks of the stream and of all existing structures upon them.

This report completes the labors of the Board in regard to the system of harbor lines necessary to be established at this time on Newtown Creek.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
WM. P. CRAIGHILL.
Colonel, Corps of Engineers.
C. B. COMSTOCK,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieut. Col. of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
December 27, 1890.

Respectfully submitted to the Secretary of War.

The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, recommends for approval the pierhead and bulkhead

lines, delineated upon the accompanying chart for Newtown Creek, New York, between the terminals at Whale Creek and Dutch Kills, established by the Secretary of War February 8, 1890, and Metropolitan avenue, the present head of navigation of the creek. These lines complete the system of harbor lines necessary to be established at this time on Newtown Creek.

It is recommended that the lines selected be approved, and that the Secretary place his approval both upon the report and upon the tracing accompanying.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Second indorsement.]

WAR DEPARTMENT,
December 29, 1890.

The harbor lines selected, as indicated on the accompanying tracing, are approved.

L. A. GRANT,
Assistant Secretary of War.

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d. HARBOR LINES FOR EAST RIVER, NEW YORK: ALONG THE NORTH SHORE FROM PORT MORRIS EASTWARD TO THROG NECK, INCLUDING ENTRANCE TO BRONX RIVER AND WESTCHESTER CREEK; ALONG THE SOUTH SHORE FROM LAWRENCE POINT EASTWARD TO WILLETS POINT, INCLUDING BOWERY AND FLUSHING BAYS, AND AROUND NORTH BROTHER, SOUTH BROTHER, BERRIEN, AND RIKER ISLANDS.

HARBOR LINE BOARD,
New York City, December 23, 1890.

GENERAL: The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, to comply with section 12 of the river and harbor act of August 11, 1888, has the honor to recommend for adoption harbor lines for East River; New York, as follows:

1. Along the north shore from Port Morris eastward to Throg Neck, including the entrance to Bronx River and Westchester Creek.

2. Along the south shore from Lawrence Point eastward to Willet Point, including Bowery and Flushing Bays.

3. Around North Brother, South Brother, Berrien, and Riker Islands.

The legal lines along East River, within the limits embraced in this report, were established April 17, 1857, by chapter 763, Laws of State of New York, 1857. They were not described by courses and distances by the State commissioners who recommended them, but were simply delineated upon maps accompanying reports submitted to the State January 27, 1857, and March 18, 1857.

The system adopted in that year provided for a single line only, which was called a pierhead and bulkhead line.

The system recommended for approval in this report provides, according to previous practice, for two distinct lines whenever the interests of commerce make such a system practicable and expedient.

Considerations which have in view the "preservation and protection" of the harbor and the better utilization of riparian rights dictate departures from the legal lines at the entrance to the Bronx River and

to Westchester Creek and in Bowery and Flushing Bays. At thes places the Board recommends that the bulkhead line be kept as close t the natural shore line as its proper rectification will admit, and that th pier-head line be advanced outward to varying distances proportionat to the capacity of the locality considered, so as to give to the riparian owner the greatest possible advantage in utilizing his water front fo the accommodation of vessels in convenient and protected berths, remot from the commercial highway.

The accompanying chart,* upon which the recommended harbor line are represented, is compiled from the latest Government and city sur veys, and is believed to be approximately accurate.

The Board would remark, however, that the improvements, made i the interest of commerce, along this part of the East River are so lim ited in extent, except from Port Morris to the mouth of the Bronx, tha the only guide available in defining the direction to be given to the har bor lines is the natural shore at high-water line. As the high-wate line on an unimproved shore is liable to be a changeable line of refer ence the Board thinks that a sufficient description of the recommended harbor lines will be afforded by a simple delineation of them upon the chart.

The Board repeats what has been stated in previous reports, that the bulkhead line defines the limit of solid filling, and the pier-head line the limit to which open-piled structures may be built.

This report completes the labors of the Board in regard to the system of harbor lines necessary to be established along the East River, New York Harbor.

Respectfully submitted.

HENRY L. ABBOT,
Col. of Engineers, Bvt. Brig. Gen., U. S A.
WM. P. CRAIGHILL,
Col. of Engineers,
C. B. COMSTOCK,
Col. of Engineers, Bvt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Col. of Engineers,
G. L. GILLESPIE,
Lieut. Col. of Engineers.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
January 8, 1891.

Respectfully submitted to the Secretary of War.

The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, recommends for adoption harbor lines for East River, New York, as follows:

1. Along the north shore from Port Morris eastward to Throg Neck, including the entrance to Bronx River and Westchester Creek.

2. Along the south shore from Lawrence Point eastward to Willet Point, including Bowery and Flushing Bays.

3. Around North Brother, South Brother, Berrien, and Riker Islands.

The lines selected are delineated on the accompanying chart, and it

* Omitted.

is recommended that they be approved, and that the Secretary place his approval both upon the report and upon the map.

With the approval of these lines the system of harbor lines necessary to be established along the East River, New York Harbor, will be complete.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

WAR DEPARTMENT,
January 9, 1891.

Approved.

L. A. GRANT,
Assistant Secretary of War.

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c. HARBOR LINES FOR JERSEY FLATS, WEST SIDE OF UPPER BAY, NEW YORK HARBOR, EXTENDING FROM MOUTH OF HUDSON RIVER AT JERSEY CITY TO CONSTABLE POINT, BERGEN NECK, NEW JERSEY.

HARBOR LINE BOARD,
New York City, June 9, 1891.

GENERAL: The Harbor Line Board for New York Harbor and its adjacent waters, constituted by Special Orders, No. 49, Headquarters Corps of Engineers, October 5, 1888, to comply with section 12 of the river and harbor act of August 11, 1888, has the honor to recommend for approval and adoption harbor lines for Jersey Flats, west side of Upper Bay, New York Harbor, extending from the mouth of the Hudson River at Jersey City to Constable Point, Bergen Neck, New Jersey.

The Jersey Flats inside the 24-foot curve measure 5,000 acres, approximately, and at low stages are covered with an average depth of 5 feet. The bed is composed generally of mud and sand, except in the vicinity of Cavan Point, where a rocky reef underlies the bed.

The water front composing the flats may be divided for this discussion into two sections, the first lying north and the second south of Cavan Point. This is a natural division, arising from the existence of the submerged rock in front of Cavan Point, which has an irregular upper surface, lying partly in the plane of mean low water and chiefly at short distances below that plane, with a covering of sand, mud, and small bowlders.

The area of rocky reef within the 21-foot curve is 34,000,000 square feet, or 780 acres.

The distance from Jersey City to Constable Point is 24,000 feet, and the average width of the flats in the northern section is 7,300 feet and in the southern section 11,700 feet.

The tidal prism for a mean range of tides of 4.4 feet is 978,000,000 cubic feet.

The two sections require to be treated differently for the reason that in the northern section the distance to deep water is comparatively short, but the bed is rocky, and deep channels can not be excavated there except at great cost; whereas in the southern section the distance to deep water is very long, owing to the westward recession of the shore line, and long channels excavated through sand or long piers are required to make the fronts available for commerce.

Three different systems of harbor lines have been previously suggested for or established on this front. The first system was sug-

gested in 1857 by the advisory council to the New York harbor commissioners appointed under the State act of New York of March 30, 1855, and consisted of a bulkhead line only, which followed the 3-foot curve adjacent to the shore. This line was never adopted by the State of New Jersey.

The second system, composed of both pierhead and bulkhead lines, was established by the riparian commissioners of New Jersey in 1864–'65. In this system the bulkhead line was placed at 3,300 feet and the pierhead line at 3,800 feet in advance of the natural shore. The distance from the bulkhead line in the northern section to deep water of the harbor was 4,700 feet and in the southern section 9,000 feet. The tidal water abstracted by this system of harbor lines was 319,000,000 cubic feet.

The third system of lines, established by the riparian commissioners in 1883, advanced the bulkhead line in the northern section to 4,000 feet, and the pierhead line to 4,500 feet from the natural shore; and in the southern section advanced the bulkhead line to 5,600 feet, and the pierhead line to 8,000 feet from the natural shore. The distance from the bulkhead line in the northern section to deep water of the harbor was then 4,200 feet, and in the southern section 6,800 feet. The tidal water abstracted by this system was 465,000,000 cubic feet.

The establishment of these last lines gave rise to three important improvements, which were carried on, respectively, by the National Storage Company at Black Tom, 2,000 feet north of Cavans Point; and by the Point Breeze Ferry and Improvement Company, and by Morris and Cumings at Palmipaw. In October 1888, when the question of establishing harbor lines for the flats first came up for consideration by the Harbor Line Board for New York Harbor and adjacent waters, the two latter companies had carried the line of solid filling to the authorized bulkhead line of 1864–'65, and were making preparations to carry it out to the authorized line of 1883, while the National Storage Company had already carried the bulkhead line on its front to the authorized line of 1883, and was ready to build piers to the authorized pierhead line of that year.

In its report, dated January 27, 1890, the Harbor Line Board recommended as the first step in the consideration of the subject that:

> All work of construction beyond the harbor lines adopted by the riparian commissioners of New Jersey in 1864–'65 be at once arrested, so as to give adequate time to the Board for the consideration of the plans for the future utilization of the shoal waters on the New Jersey shore, known as Jersey Flats.

This recommendation was approved by the Secretary of War February 1, 1890.

During the past year the subject has had the earnest and constant attention of the Board, which has had the one desire that every riparian interest should be promoted consistently with the "preservation and protection" of the harbor of New York.

Following its usual custom in like cases, the Board has recognized that the lines previously established by the State of New Jersey gave certain water rights, more or less valuable, to the riparian owners which should not be abridged unless the "preservation and protection" of the harbor urgently demanded it. Owing to the shoal depths on the Flats—nowhere exceeding 7 feet, and the average being less than 6 feet, mean low water—and to the great width of the Flats, obstructed also in the northern section by rocky reefs, the riparian owners have not been able heretofore to use their water fronts profitably in the usual way for commercial purposes. The excessive cost, not justified by the demands

of commerce, of excavating long and deep channels, or building long piers to deep water, has prohibited improvements on this front, except by corporations controlling large sums of money. Lately the shore fronts have been bought up largely by railroad companies, who now state that they are ready to improve and utilize these fronts whenever the Government establishes final harbor lines.

The Board has held 11 public meetings during the past two years, which have been largely attended by all parties in interest, at which the advantages and disadvantages of the several proposed plans of improvement, submitted at the request of the Harbor Line Board, have been fully and intelligently discussed. The Board has had also frequent conferences with the riparian commissioners of New Jersey, including the governor of the State at one conference, and has solicited and received suggestions from them in regard to the most feasible and equitable method of utilizing the Flats.

As early as December, 1888, the Point Breeze Ferry and Improvement Company submitted plans for improving its property at Palmipaw by the erection of a long pier running out from the shore to deep water, and terminating in a wide solid pierhead for the convenient handling and storage of freight.

In September, 1890, the riparian commissioners submitted a plan for the formation of two distinct artificial islands, measuring 133.6 acres in the aggregate, on the line between Bedloe Island and Robbins Reef Light, and separated by a navigable channel 1,000 feet wide leading to an interior channel, also 1,000 feet wide and 25 feet deep, mean low water, running north and south over the Flats, and communicating with all the piers built, or to be built, under rights previously conveyed by the State to the riparian owners. It was proposed in these plans to connect the islands with the shore by railroad tracks supported upon pile bents, which should be provided with adequate drawbridges at the points of crossing the interior channel.

Later the Pennsylvania Railroad Company submitted plans for improving and utilizing its front; the National Storage Company plans for improving its front at Black Tom Island, and the Lehigh Valley Railroad Company plans for its front at Constable Point.

The public hearings in March, April, and May, 1891, were very largely attended by parties in interest, and the plans submitted by the riparian commissioners of New Jersey for the formation of artificial islands were discussed in great detail, and condemned by many of the riparian owners on the ground that such an improvement would be disastrous to the shore property where rights had been acquired by purchase from the State in covenants which forever prohibited any grants exterior to them. It was further protested that the formation of an interior channel between the artificial islands and the shore, crossed by railroads over which trains and locomotives would pass at short intervals, would impose an unreasonable, onerous, and ruinous tax upon the use of the shore piers and wharves.

The riparian commissioners alleged, in reply to these protests, that their action in preparing and proposing the plans was in compliance with the State act of February 10, 1891, which authorizes them "to fix lines around islands, reefs, and shoals," and that the plans submitted for the occupancy of the outer shoals of the flats by solid constructions, with open shore connections, had their approval.

The Board did not feel empowered by the Congressional act under which it was organized, or by the orders of the Chief of Engineers, by which it was instituted, to consider a legal question of the nature of

that involved in the dispute between the riparian commissioners of the State and the riparian owners, and therefore confined its consideration of the commissioners' plans for the occupancy of the outer shoals to the engineering principles governing the preservation of the harbor. While keeping in view the commercial interests of the harbor, which were to be preserved and protected by the proposed new system of harbor lines, the Board has felt that the peculiar configuration of the natural shore line on the west bank and the shoal, as well as the rocky character of the flats, should incline it to make concessions in fixing the harbor lines, which would render it possible for the riparian holders to utilize, at reasonable cost, their shore fronts by comparatively permanent structures adapted to the uses of commerce, provided such concessions could be made without endangering the maintenance of the ship channel across the shoals which lie at the outer entrance to the harbor.

After weighing all the arguments which have been used by the various parties in interest in favor of their own plans, the Board recommends that the bulkhead line on the Jersey Flats be fixed as follows: That the straight portion parallel to the natural shore line of the bulk head line south of the south side of Cavans Point, which was fixed by the riparian commissioners of New Jersey in 1864–'65, be advanced 350 feet; that the curved portions of the same line, extending, respectively, to Constable Point on the south and to a point 3,300 feet slightly south of east of the eastern end of Cavans Point on the north, remain unchanged; and that the bulkhead line to be established to the northward and eastward of Cavans Point follow the bulkhead line fixed by the riparian commissioners of New Jersey in 1883 until it intersects the pierhead line of 1864–'65; thence along the latter line 1,700 feet to a point opposite the northwest corner of pierhead and bulkhead line, west side of Ellis Island; thence at right angles 500 feet toward the shore to the bulkhead line of 1864–'65, and thence along that line to its eastern terminus. The Board also recommends that the pierhead line beginning at the southern terminus of the pierhead line in front of Communipaw Ferry, Jersey City, established by the Secretary of War March 4, 1890, run south 500 feet along the pierhead line fixed by the riparian commissioners of New Jersey in 1883; thence in a straight line to the northwest corner of the pierhead and bulkhead line, west side of Ellis Island; thence south along that line on the west side, as now established, to the southwest corner; thence south in a straight line to a point 2,000 feet due west of Robbins Reef light, and thence a straight line to the eastern terminus of the pierhead line at Constable Point, established by the Secretary of War January 4, 1890. The Board further recommends, as surety for proper constructions, that no structures be allowed to be built between the recommended pierhead and bulkhead lines until after the plans for the same have been approved by the Secretary of War. This precaution is highly important.

These recommendations by the Board need a word of explanation. The bulkhead line now submitted for adoption diminishes the tidal prism of the harbor by 350,000 cubic feet, which is the most that the Board think can be safely authorized without the risk of changing those tidal conditions which serve to maintain the existing improved depths at the entrance across the outer bar.

The pierhead line, situated at a maximum distance of 2,800 feet, and at an average distance of 2,000 feet from the deep water of the harbor, can be made available for the use of deep-draft vessels only after the excavation of adequate channels.

Among the reasons which have influenced the Board in its recommendation that the pierhead line should be established inside the eastern border of the Flats, is the fact that when the piers along the front are built there will be a large congregation of vessels entering which might seriously interfere with the existing valuable anchorage in this vicinity.

In every respect, except the shoalness of the water, the western shore affords a better harbor than the eastern shore, for the reason that it is the windward side, giving most complete shelter for the anchorage of vessels while awaiting accommodation at the wharves. The Government has therefore very wisely reserved and marked by buoys an anchorage ground on the west side of the upper bay, extending along the whole front of the Jersey Flats, and having its eastern border located at a maximum distance of 2,000 feet from the eastern border of the Flats.

The anchorage grounds on the Hudson and East Rivers are very limited in extent and are not well located for convenient use by vessels. The anchorage on the east shore of the Upper Bay is in shoal water and much exposed to wind.

This report is accompanied with a tracing* which shows the location and direction of the recommended harbor lines for the Jersey Flats, drawn from the data used by the riparian commissioners of New Jersey in locating the lines previously established by them.

The offsets shown upon the tracing sufficiently determine the location and direction of the new lines, of which no further description is deemed necessary.

The term "pierhead" is applied in general to lines beyond which no pile structure shall extend, and the term "bulkhead" to lines beyond which no solid filling shall thereafter be permitted.

A supplementary map*, not designed to be printed, upon which the recommended lines are delineated in relation to the three systems of harbor lines previously suggested for or established on this front, is transmitted for the purpose of elucidating this report, which might otherwise be obscure.

Respectfully submitted.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
WM. P. CRAIGHILL,
Colonel of Engineers.
C. B. COMSTOCK,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.
D. C. HOUSTON,
Colonel of Engineers.
G. L. GILLESPIE,
Lieutenant-Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

[First indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
June 23, 1891.

Respectfully submitted to the Secretary of War.

The Harbor Line board for New York and its adjacent waters constituted by Special Orders, No. 49, Headquarters Chief of Engineers, Octo-

*Not printed.

ber 5, 1888, recommends for the approval of the Secretary of War harbor lines for Jersey Flats, west side of Upper Bay, New York Harbor, extending from the mouth of the Hudson River at Jersey City to Constable Point, Bergen Neck, New Jersey, described in the within report and delineated upon the accompanying chart.

It is recommended that the lines be approved and that the Secretary place his approval both upon the report and the tracing submitted.

THOS. LINCOLN CASEY,
Brigadier-General, Chief of Engineers.

A request from the secretary of the riparian commissioners of New Jersey for a hearing before the Secretary of War on this subject is herewith.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Third indorsement.]

WAR DEPARTMENT,
July 28, 1891.

Respectfully returned to the Chief of Engineers, with a communication from the riparian commissioners of New Jersey, dated July 20, 1891, and maps accompanying the same.

Also numerously signed petitions from citizens of Bayonne in reference to the canal and basin usually known as Packard's.

Also a communication from R. D. Benedict, attorney for Mr. Packard, dated July 20, 1891.

Particular attention is called to these petitions, and the points made for Mr. Packard in the communication of Mr. Benedict.

It is a serious question, which perhaps will have to be determined by the courts, whether the Government has a right to run harbor lines across land not covered with water. It can do no good, unless the land shall be subsequently taken and excavated. If the land is private property (as most land is) it can not be taken or excavated without due process of law and compensation, probably requiring special legislation by Congress.

It is not expected that the Board will decide questions of law, but it is proper for the Chief of Engineers and the Harbor Line Board to consider, in view of the difficult questions presented and the litigation likely to follow, whether it would not be expedient to avoid these by running the lines around the land in question.

And in reference to running the lines across navigable water the question presents itself whether it would not be better and more expedient in this case to run the lines around the Packard Canal and Basin, as is claimed in Mr. Benedict's communication has been done in numerous other instances in the New York Harbor, particularly the Atlantic Basin, and the Erie Basin, and the proposed basins, which are said to be artificial, and not distinguishable from the Packard Canal and Basin.

These papers are not returned disapproved or with instructions, but with the suggestion that possibly the Chief of Engineers, after examining all the papers and considerations urged, may think it best to resubmit the question of the expediency of going around the Packard Canal and Basin.

It is understood that Bayonne is a growing city of 25,000 inhabitants,

and that this canal and basin may be important to the navigation and growth of the city.

Such action as the Chief of Engineers may take in the premises will doubtless receive the approval of the Department.

L. A. GRANT,
Acting Secretary of War.

[Fourth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
July 30, 1891.

Respectfully returned to the Harbor Line Board for New York Harbor and its adjacent waters for further report, attention being invited to the indorsement of the 28th instant by the Acting Secretary of War and the accompanying papers.

These papers to be returned to this office.

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

[Fifth indorsement.]

THE NEW YORK HARBOR LINE BOARD,
New York City, August 7, 1891.

Respectfully returned to the Chief of Engineers.

The Board has carefully considered the accompanying communication, presented by the board of riparian commissioners of New Jersey, protesting against the harbor lines recommended by this Board on June 9, 1891, for the water front along the New Jersey Flats, and find nothing therein to modify the views already expressed. The whole subject was very carefully considered before taking action.

In the special matter of Mr. Packard's basin and proposed water connection, a further hearing has been given to-day to the representatives of the Bergen Neck Railroad Company, in presence of Mr. Packard and his counsel. After considering what was stated and the accompanying documents, the Board has decided to advise no changes in the harbor lines in this vicinity, originally recommended.

The Board regards Mr. Packard's channel as of marked benefit to the public, and has no wish to interfere in any way with its maintenance or further improvement, but his equitable rights are not prejudiced by the lines as recommended, as will appear from the following considerations:

In regard to the allegation that the harbor lines recommended cross "land not covered with water," the Board would say that the land to which reference is made consists of material originally lying along the line of the proposed channel to the basin at Bayonne, which the dredges of Mr. Packard turned over in place in 1888 at the time he was engaged upon excavations for the basin and its proposed water connection. The dredging and dumping were one operation, and this method was adopted for its economy. This operation was discontinued after the Secretary of War established the temporary bulkhead line on February 1, 1890. The land is now at or near the level of low water, and at high stage is covered with water which has an approximate depth of 4 feet. Beyond the State bulkhead line of 1864–'65 Mr. Packard has made no construction now above low water, except a stone heap at the pierhead line of 1864–'65 and piles or crib work on the bulkhead and pierhead lines of 1884.

There appears to be misapprehension as to the effect of running harbor lines across land not covered by water.

Owing to irregularities in the shores of rivers and harbors lines have frequently been established by the Secretary of War across points of land. The object of this is to prevent structures or deposits *in water exterior to the lines.* The mere laying out of these lines does not compel the removal of private property, which can only be done with the consent of the owner or by condemnation proceedings and compensation, as provided in the acts of Congress appropriating money for the improvement of harbors and rivers.

The location of harbor lines in the Jersey Flats across the channel excavated by Mr. Packard, and the filling which he has made on the sides of the channel, does not affect any of his property rights, nor was there any intention to do so.

In reference to establishing lines in the Packard channel and basins, the Board sees no necessity therefor. In its report dated January 20, 1890, the Board stated that, in recommending harbor lines, it—

> Has considered that while no solid filling could be made outside of such lines when approved and established by the Secretary of War, the determination of the kind and extent of filling, excavations, and structures inside those lines should be left to the riparian owners under regulation by local authority, whether of State, county, city, or town.

Mr. Packard can, therefore, so far as the United States is concerned, make such improvements as he desires inside of the bulkhead line, and he is more free to do so than if hampered by harbor lines definitely located.

The Board did not recommend the establishment of any lines inside of the Atlantic and Erie basins in Brooklyn, as appears from the report of the Board dated February 18, 1890 (Report of the Chief of Engineers for 1890, page 810), which contains the following resolution:

> *Resolved,* That the present legal pier and bulkhead lines between Broadway Ferry, Brooklyn, and the northern boundary of the Government land at Fort Hamilton be recommended for approval, except that the pier and bulkhead lines exterior to the Erie Basin be made coincident with the present bulkhead line there.

The Board simply confirmed the legal lines already established by the State of New York. except in the case of the Erie Basin, where a wall had been built exterior to those lines. The outer line of this wall was recommended as the pier and bulkhead line.

> The Board recommended in its report of June 9, 1891, that no structures be allowed to be built between the recommended pier-head and bulkhead lines until after the plans for the same have been approved by the Secretary of War.

Should the report of the Board be approved, it will be proper for Mr. Packard to submit plans for any work he proposes within these limits for the action of the Secretary of War, when all matters affecting his interests can be considered.

For the Board.

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
President of the Board.

[Sixth indorsement.]

OFFICE CHIEF OF ENGINEERS, U. S. ARMY,
August 11, 1891.

Respectfully returned to the Secretary of War.
Summary of case is given in first indorsement.
The papers having been returned to this office with indorsement of

the Acting Secretary of War of the 28th ultimo were referred to the Board of Engineers for further report. The Board has carefully reconsidered the subject, and has decided to advise no change in the harbor lines in this vicinity originally recommended.

The views of the Board are concurred in by this office and the recommendation contained in the first indorsement is renewed.

A letter of July 17, from Messrs. Dickinson and Thompson, counsel with the Bergen Neck Railway Company, referred to in the indorsement of the Assistant Secretary of War of August 1, 1891, is herewith. It was * * * received at the War Department July 18.

H. M. ADAMS,
Major, Corps of Engineers, in Charge.

WAR DEPARTMENT,
August 19, 1891.

The within report of the Harbor Line Board is approved.

L. A. GRANT,
Acting Secretary of War.

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f. MODIFICATION OF PIER AND BULKHEAD LINES ON THE NORTH SHORE OF STATEN ISLAND BETWEEN JOHN STREET AND HOUSEMAN AVENUE PRODUCED.*

HOUSE OF REPRESENTATIVES, U. S.,
Washington, D. C., June 20, 1890.

MY DEAR SIR: Under what is known as the river and harbor bill of 1888 a Board of Engineers was appointed by the Secretary of War to lay out pier and bulkhead lines for the harbor of New York. Colonel Gillespie, U. S. A., took charge of most of the work, and advertised hearings were had in the city of New York to take testimony, etc., for the purpose of the work. It was my purpose to be present at those of the hearings that related to that part of the harbor known as the Kill von Kull, on the north shore of Staten Island. I was called out of the city and left the matter in charge of another, who neglected to do what I required, as I only recently discovered. My people own about 600 feet of water front on the north shore of Staten Island, on both sides of what is called Morning Star road. The road is one of the principal streets on Staten Island, and runs entirely across it from the north to the south shore.

By reference to the map approved by the Secretary of War January 4, 1890, fixing the pier and bulkhead lines, it will be seen that the pier and bulkhead lines at foot of said road are identical, and that they incline to the shore at the foot of the road. On the inclosed map,† which is a copy of the map approved by the Secretary of War, I have marked the space between the foot of Houseman avenue and the foot of John street, which includes the whole of the shore where the pier line inclines, and have caused to be inserted thereon the soundings taken from hydrographic sheet No. 1716, U. S. Coast Survey.

I most respectfully ask that that part of the shore of Staten Island referred to be sent back to the Board of Engineers for a hearing, to show reasons why the pier and bulkhead line between Houseman avenue and John street should be extended so that the monument at the

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* See Annual Report Chief of Engineers for 1890, page 789.
† Omitted.

foot of Morning Star road be located on a point in a straight line drawn between said avenues projected. The following are some of the reasons why I ask that such correction be made:

The Morning Star road is one of the principal roads in Staten Island. It will eventually become a landing place for all that section. The soundings at the monument now located are about 7 feet. It is on the middle of a shoal extending from the channel to the high-water mark. The bottom is hard. If extended to the point desired it would bring the pier line to the edge of the channel. The place can not be dredged, because the whole shore line is in the same high incline.

The distance between the pier line on Staten Island and the pier line on the Jersey shore at this point is nearly 2,000 feet. At points directly below it is but little more than 500 feet across the river, and this distance continues with little variation throughout the whole length of the river.

The angle formed by the present pier line will form a jog or cove, into which all the sewage and driftwood will be deposited, as it is to-day, causing it gradually to fill up and making the water shallow.

The harbor commissioners of the State of New York in 1857 located the pier line as we now desire it, but this has been changed. We can not conceive of any reason which can be urged against the change. It will not seriously change the width of the river, and the river at this point is more than twice as wide as it is at any other point.

It will give the upland desirable water privileges.

It will give a better channel for the river to flow and help to remove the sewage, clean the river, and give a more rapid current to empty the waters into the sea. It will make more symmetrical the pier line and restore it to what it originally was.

I hope that these reasons may be sufficient to convince you of the necessity of a rehearing, and I am confident that the Board of Engineers will see the urgency of our claim if an opportunity be afforded of explaining it to them.

With assurances of respect and esteem, I am, sincerely yours,

THOS. F. MAGNER.

Hon. REDFIELD PROCTOR,
Secretary of War.

[Third indorsement.]

NEW YORK HARBOR LINE BOARD,
New York City, July 15, 1890.

Respectfully returned to the Chief of Engineers.

The harbor line in this locality would probably have had a different position had there been no structure in existence and no previous action by the State authority. It was adopted because it was a line already established by the State of New York, interfered as little as possible with existing structures, and was not injurious to the regimen of the stream. It is a matter of little importance whether the line remains as already approved or be drawn straight between the points on the pier and bulkhead line as now established on the extension of John street and Houseman avenue. This was the line of 1857, as stated by Mr. Magner, but it was superseded by the State act of 1881, which latter defined the line which was approved by the Secretary of War.

For the Board:

HENRY L. ABBOT,
Colonel of Engineers, Bvt. Brig. Gen., U. S. A.,
President of the Board.

[Eighth indorsement.]

OFFICE CHIEF OF ENGINEERS,
U. S. ARMY,
August 11, 1890.

Respectfully returned to the Secretary of War.

The Hon. Thomas F. Magner, M. C., having requested that the pier and bulkhead line along the north shore of Staten Island, as established by the Secretary of War January 4, 1890, be modified between John street and Houseman avenue extended, the Assistant Secretary of War, by indorsement of July 25, directed that the change asked for by Mr. Magner be made.

The accompanying tracing,* upon which is delineated the modification of the line, as desired by Mr. Magner, received at this office with inclosed letter of the 8th instant from the Board of Engineers, is respectfully submitted, having been prepared for approval of the Secretary of War.

H. M. ADAMS,
Major, Corps of Engineers, in Charge.

[Ninth indorsement.]

WAR DEPARTMENT,
August 15, 1890.

Respectfully returned to the Chief of Engineers.

The modification of the line, as delineated on the accompanying tracing, is approved.

L. A. GRANT,
Assistant Secretary of War.

*Omitted.

INDEX.

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
A.						
Aberdeen, Wash., bridging Chehalis River at	430					
Acts of Fifty-first Congress, second session, affecting Corps of Engineers	477					
Agate Bay Harbor, Minn., improvement of	311			2486		
Ahnapee Harbor, Wis., improvement of	321			2538		
Alabama River, Ala., improvement of	204		1738			
Alabama River, Ala., up to Wetumpka, examination of	211		1761			
Albemarle Sound, N. C., and Norfolk Harbor, Va., water way between, improvement of	151	1302				
Alexandria, La., bridging Red River near	430					
Allegheny Bridge Company, bridge of, across Allegheny River, Pa	431					
Allegheny River, Pa., at Sixth street, Pittsburg, bridging	431					
Allegheny River, Pa., dam at Herr Island, construction of	292			2366		
Allegheny River, Pa., improvement of	292			2363		
Allouez Bay, at Superior, Wis., examination of	316			2512		
Alloway Creek, N. J., improvement of	117	1086				
Alsea Bay, Oregon, examination of	409				3246	
Alsea River, Oregon, examination of	409				3246	
Altamaha River, Ga., improvement of	181		1531			
Alton, Ill., bridging Mississippi River at	432					
Alviso Creek, Cal., examination of	393				2964	
Alviso Harbor, Cal., examination of	393				2964	
Amesbury, Mass., bridge across Powow River at	427					
Amite River, La., improvement of	223		1820			
Anacostia River. (*See* Eastern Branch of Potomac River.)						
Annie J. Russell (schooner), removal of wreck of	32 609					
Apalachicola Bay, Fla., improvement of	196		1694			
Apalachicola River, Fla., improvement of	197		1696			
Appomattox River, Va., improvement of	150	1300				
Appoquinnimink River, Del., improvement of	121	1161				
Approaches to Norfolk Harbor, Va., improvement of	146 147	1291 1296				
Aqueduct, Washington, maintenance and repair of	436					3875
Aquia Creek, Va., improvement of	139	1255				
Aransas Bay, Tex., examination for removal of Half-Moon Reef	235		1942			
Arkansas River, Ark., at Dardanelle, bridging	430					
Arkansas River, Ark., Ind. T., and Kans., improvement of	250			2037		
Arkansas River, Ark., Ind. T., and Kans., removing obstructions in	249			2033		
Arthur Kill, N. Y. and N. J., improvement of	97	983				
Arthur, Lake, La., course of Mermenton River through, examination and survey of	230		1858			
Ashland Harbor, Wis., improvement of	313			2500		
Ashley River, S. C., bridge obstructing	433					
Ashley River, S. C., improvement of	176	1476				
Ashtabula Harbor, Ohio, improvement of	372				2863	
Astoria Harbor, Oregon, establishment of harbor lines in	18 427				3387	
Astoria, Oregon, and Woods Landing, Columbia River between, examination for snagging	420				3380	

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Astoria, Oregon, wreck in Columbia River near, removal of	420				3373	
Atchafalaya River, La., to Cottonport, Bayou des Glaises from, examination of	230		1854			
Atlantic City, thoroughfare between Great Bay north of, and Cape May, N. J., examination of	118	1097				
Augusta, Ga., bridge obstructing Savannah River below	435					
Augusta, Me., and Waterville, Me., Kennebec River between, examination and survey of	33					
Au Sable Harbor, Mich., improvement of	351				2771	
B.						
Back Cove, Portland, Me., bridge obstructing channel to	435					
Back Cove, Portland, Me., improvement of channel in	27 597					
Bagaduce River, Me., improvement of	22 578					
Balltown, Pa., and Tionesta, Tionesta Creek between, examination of	294				2381	
Baltimore and Ohio Southwestern Railroad Company, bridge of, obstructing Muskingum River, Ohio	434					
Baltimore Harbor, Md., improvement of	132		1227			
Barnegat Bay and Great Egg Harbor Bay, N. J., sound between, examination of	118		1093			
Barnegat Inlet, N. J., removal of wreck in	118		1090			
Barnstable, Mass., bridging channel between Little Island and mainland at Osterville, in town of	431					
Barren River, Ky., operating and keeping in repair lock and dam on	304				2439	
Bartholomew, Bayou, La. and Ark., improvement of	240				1982	
Bath, Me., Kennebec River at, establishment of harbor lines in	18 424 622					
Battalion of Engineers	15 540					
Batteries, construction of	5					
Bay Ridge Channel, New York Harbor, N. Y., examination of	94 940					
Bay Ridge Channel, New York Harbor, N. Y., improvement of	90 917					
Bay River, N. C., and Pamlico River, N. C., water way between, examination of	170		1421			
Bayou Bartholomew, La. and Ark., improvement of	240				1982	
Bayou Black, La., and Bayou Terrebonne, examination for connection between	229			1846		
Bayou Black, La., for connection between Calcasieu Lake and Sabine Lake, examination of	230			1850		
Bayou Bœuf, La., improvement of	241				1985	
Bayou, Buffalo, Tex., improvement of	234			1924		
Bayou Carlin, La., examination of	229			1838		
Bayou Castor, La., examination of	249				2028	
Bayou, Cedar, Tex., improvement of	233			1922		
Bayou Chevreuil, La., examination of	229			1841		
Bayou Cocodrie, St. Landry Parish, La., examination of	229			1849		
Bayou Courtableau, La., improvement of	225			1826		
Bayou, Cypress, and lakes between Jefferson, Tex., and Shreveport, La., survey of	248				2021	
Bayou D'Arbonne, La., improvement of	240				1980	
Bayou des Glaises, La., from Atchafalaya River to Cottonport, examination of	230			1854		
Bayou, Double, Chambers County, Tex., mouth of, examination of	235			1933		
Bayou La Fourche, La., improvement of	224			1821		
Bayou, La Grange, Fla., improvement of	200			1704		
Bayou Maçon, La., improvement of	241				1989	
Bayou Manchac, La., improvement of	223			1820		
Bayou Plaquemine, La., bridge obstructing	434					
Bayou Plaquemine, La., improvement of	225			1824		
Bayou Plaquemine, La., securing mouth of, from further caving	231			1867		
Bayou Rondeway, La., improvement of	242				1992	
Bayou, Steele, Miss., improvement of	244				2005	
Bayou Teche, La., between St. Martinsville and Port Barre, examination of	230			1852		
Bayou Teche, La., improvement of	226			1828		

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Bayou Terrebonne, La., and Bayou Black, examination for connection between	229		1846			
Bayou Terrebonne, La., between Houma and Thibodeaux, examination of	229		1843			
Bayou Terrebonne, La., improvement of	224		1823			
Bayou Tigre, La., examination of	229		1841			
Bayou Vermillion, bay and passes, La., examination of	230		1855			
Bayou Vidal, La., improvement of	242			1992		
Bayou, Washington, Miss., improvement of	244			2005		
Beaufort Harbor, N. C., improvement of	161	1367				
Beaufort, N. C., and New Berne, N. C., water way between, improvement of	160	1363				
Beaufort, N. C., and New River, N. C., water way between, improvement of	162	1372				
Beaufort River, S. C., improvement of	178	1485				
Beaver River, Pa., movable dam in Ohio River near mouth of, construction of	290			2354		
Bee Tree Shoals, Ala., foot of, and Chattanooga, Tenn., Tennessee River between, improvement of	286			2303		
Bee Tree Shoals, Ala., Tennessee River below, improvement of	279			2255		
Belfast Harbor, Me., improvement of	23	586				
Bellamy River, N. H., improvement of	30	605				
Ben Hur (tender), removal of wreck of	362				2801	
Benjamin Gartside (schooner), removal of wreck of	61	731				
Berwick Bay, La., to Gulf of Mexico, examination of	229		1847			
Bickmore, S. S. (schooner), removal of wreck of	62	732				
Big Barren River, Ky., above Bowling Green, examination of	310			2474		
Big Barren River, Ky., Green River above mouth of, examination of	310			2478		
Big Black River, Miss., improvement of	242			1993		
Big Blackfoot River, Mont., mouth of, and international boundary line, Clark Fork of Columbia River between, examination of	409				3250	
Big Hatchee River, Tenn., improvement of	246			2010		
Big Sandy River, Levisa Fork of, Ky., improvement of	307			2466		
Big Sandy River, Russel Fork of, Ky., examination of	310			2476		
Big Sandy River, Tug Fork of, 91 and 95½ miles above Catlettsburg, Ky., bridging	431					
Big Sandy River, Tug Fork of, W. Va. and Ky., improvement of	308			2467		
Big Sandy River, W. Va. and Ky., improvement of	307			2463		
Big Sioux River, mouth of, and north line of South Dakota, Missouri River between, examination and survey of	277			2242		
Big Stone Lake, Minn. and S. Dak., examination and survey of	274					
Big Sunflower River, Miss., improvement of	245			2007		
Bills authorizing construction of bridges, examination of	18					
Biloxi Harbor, Miss., improvement of	219		1793			
Black, Bayou, La., and Bayou Terrebonne, examination for connection between	229		1846			
Black, Bayou, La., for connection between Calcasieu Lake and Sabine Lake, examination of	230		1850			
Black Lake Harbor, Mich., improvement of	341				2696	
Black River, Ark. and Mo., improvement of	254			2053		
Black River, Ark. and Mo., obstruction of, by logs, and injury to dam on						3808
Black River Harbor, Ohio, improvement of	369				2849	
Black River, La., improvement of	238			1964		
Black River, Mich., at Port Huron, improvement of	354				2780	
Black River, Mich., mouth of, improvement of	355				2782	
Black River, Mo., improvement of	255			2058		
Black River, N. C., improvement of	164		1387			
Black River, S. C., below Kingstree, examination of	170		1435			
Black River, Wash., examination of	409				3257	
Black Rock Harbor, Conn., improvement of	70	784				
Black Warrior River, Ala., between Tuscaloosa and Daniels Creek, improvement of	215		1784			

Subject.	Page. Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Block Island, R. I., harbor of refuge at	59 723					
Blue Hill Harbor, Me., examination of	32 611					
Bluff Creek, Miss., improvement of	218		1792			
Board of Engineers, The	11					
Boards:						
On examination for deep-water harbor on Pacific coast between Points Duma and Capistrano, Cal	394					
On examination for harbor of refuge near mouth of Delaware Bay	119	1120				
On examination for ship canal to connect Lakes Union, Washington, and Samamish with Puget Sound, Wash	412					
On improvement of Hudson River, N. Y.	82 866					
On improvement of Sacramento and Feather rivers, Cal	396				2990	
On investigation of mining-débris question in California	399				2996	
On reëxamination of Port Orford Harbor, Oregon	411				3305	
On survey for improvement of Wilmington Harbor, Del	120	1138				
On valuation of channel constructed by Buffalo Bayou Ship Channel Company in Galveston Bay, Tex	233		1906 1910			
Bœuf, Bayou, La., improvement of	241			1985		
Bœuf River, La., improvement of	241			1985		
Bogue Chitto, La., improvement of	220		1800			
Bogue Falia, La., improvement of	222		1818			
Bogue Sound, N. C., improvement of		1372				
Boquet River, N. Y., below Willsboro, examination of	388				2940	
Boston Harbor, Mass., construction of casemates at	6					
Boston Harbor, Mass., defense of	5 6					
Boston Harbor, Mass., establishment of harbor lines in	18 424 688					
Boston Harbor, Mass., improvement of	40 645					
Bowling Green, Ky., Big Barren River above, examination of	310			2474		
Brazos River, Tex., below Waco, examination of	235					
Brazos Santiago Harbor, Tex., improvement of	234		1930			
Breakwaters:						
At Gordon Landing, Lake Champlain, Vt.	385				2930	
At mouth of Saco River, Me	28 598					
At New Haven, Conn	68 766					
At Rouse Point, Lake Champlain, N. Y.	384				2927	
From Mount Desert to Porcupine Island, Me	21 576					
Occupancy of and injury to, by corporations or individuals	19 436					3865
Breton Bay, Md., harbor at, improvement of	140	1258				
Bridgeport Harbor, Conn., improvement of	70 778					
Bridges, examination of bills authorizing construction of	18					
Bridges in Yellowstone National Park, construction and improvement of	447					3931
Bridges obstructing navigation	18 433					
Bridges proposed to be built across navigable waters, examination of plans and locations of	18 427					
Bridging navigable waters of United States	18 42[illegible]					3853
Broad Creek, Md., examination and survey of	132	1221				
Broad Creek River, Del., examination of	131	1209				
Broadkiln River, Del., improvement of	122	1157				
Bronx River, N. Y., examination and survey of	94 949					
Browns Creek, Sayville, N. Y., improvement of	79 828					
Bruce (bark), removal of wreck of	228		1837			
Brunswick, Ga., outer bar, examination and survey of	185					
Brunswick Harbor, Ga., improvement of	182		1550			
Buckhannon River, W. Va., improvement of	309			2474		
Budd Inlet, Olympia Harbor, Wash., from, examination and survey of	411					
Buffalo Bayou Ship Channel Company, valuation of channel constructed in Galveston Bay, Tex., by	233		1906 1910			
Buffalo Bayou, Tex., improvement of	234		1924			

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Buffalo Harbor, N. Y., improvement of	375				2882	
Buffalo Harbor, N. Y., occupancy of north pier at						3872
Buffalo, N. Y., ship channel in connecting waters of the Great Lakes between, Chicago and Duluth, examination of	362				2810	
Building materials, tests of	551 565					
Buildings, public, D. C., improvement and care of	444					3907
Burlington Harbor, Vt., improvement of	386				2932	
Buttermilk Channel, New York Harbor, N. Y., examination of	93 937					
Buttermilk Channel, New York Harbor, N. Y., improvement of	88 911					
C.						
Cable City Bridge Construction Company, bridge of, across Arkansas River at Dardanelle, Ark	430					
Cable galleries, construction of	6					
Cache River, Ark., improvement of	253				2051	
Cahaba River, Ala., improvement of	210			1754		
Calcasieu Lake, La., and Sabine Lake, connection between, via Bayou Black, examination of	230			1850		
Calcasieu River, La., mouth and passes of, improvement of	226			1829		
California, investigation of mining-débris question in	399					2996
Caloosahatchee River, Fla., improvement of	189			1643		
Calumet Harbor, Ill., improvement of	330				2602	
Calumet River, Ill. and Ind., improvement of	331				2606	
Cambridge Harbor, Md., improvement of	127		1191			
Camden, Ark., Ouachita River above, improvement of	239				1975	
Camden Harbor, Me., improvement of	24 587					
Camden, N. J., establishment of harbor lines at	425		1122			
Camden, N. J., harbor at, improvement of	110		1029			
Camden, S. C., Wateree River between, and Falls of the Catawba; and bend about 4 miles below, examination of	179	1487				
Canals:						
Cascades Canal, Columbia River, Oregon, construction of	414					3328
Coosa River, Ga. and Ala., operating and care of locks and dams, etc., on	210		1753			
Des Moines Rapids Canal, operating and care of	266				2174	
Fox River, Wis., operating and care of locks and dams on	329				2580	
Great Kanawha River, W. Va., operating and care of locks and dams on	300				2425	
Green and Barren rivers, Ky., operating and keeping in repair locks and dams on	304				2439	
Illinois and Mississippi Canal, construction of	334				2633	
Illinois River, Ill., operating and care of La Grange Lock	333				2630	
Kentucky River, Ky., operating and keeping in repair locks and dams on	306				2455	
Louisville and Portland Canal, Ky., operating and care of	296				2394	
Monongahela River, operating and care of Locks and Dams Nos. 8 and 9	291				2357	
Monongahela River, purchase of Lock and Dam No. 7	291				2359	
Monongahela River, purchase of Lock and Dam No. 6	291				2360	
Muscle Shoals Canal, Tennessee River, operating and care of	287				2322	
Muskingum River, Ohio, operating and care of locks and dams on	293				2369	
Portage Lake, Mich., with Lake Superior and Keweenaw Bay, purchase of canals connecting	17					
St. Clair Flats Canal, Mich., improvement of	356					2784
St. Clair Flats Canal, Mich., operating and care of	358					2787
St. Marys Falls Canal, Mich., operating and care of	346					2724

Subject.	Page. Part I.		Part II.	Part III.	Part IV.	Part V.	Part VI.
Canapitsit Channel, Mass., examination and survey of	62						
Canarsie Bay, N. Y., improvement of	95		980				
Cane River, Laexamination of	249				2022		
Caney Fork River, Tenn., improvement of	284				2284		
Cape Ann, Mass., harbor of refuge at Sandy Bay	36	632					
Cape Charles City Harbor, Va., and approaches by Chenton (Cherrystone) Inlet, improvement of	130		1199				
Cape Fear, North East River, N. C., improvement of	164		1383				
Cape Fear River, N. C., above Wilmington, improvement of	165		1390				
Cape Fear River, N. C., at and below Wilmington, improvement of	166		1394				
Cape May and Great Bay north of Atlantic City, N. J., thoroughfare between, examination of	118		1097				
Cape May City, N. J., examination for breakwater at	118		1099				
Capistrano Point and Point Duma, Cal., deep-water harbor on Pacific coast between, examination for	394						
Carlin, Bayou, La., examination of	229			1838			
Carquinez Strait, Cal. (*See* Karquines Strait.)							
Carthage, Miss., and Edinburg, Miss., Pearl River between, improvement of	220			1799			
Carthage, Miss., and Jackson, Miss., Pearl River between, improvement of	220			1797			
Cascades Canal, Columbia River, Oregon, construction of	414						3328
Casemates, construction of	6						
Castor, Bayou, La., examination of	249				2028		
Catawba, Falls of the, and Camden, Wateree River, S. C., between, examination of	179		1487				
Catlettsburg, Ky., bridging Tug Fork of Big Sandy River, 91 and 95½ miles above	431						
Cedar Bayou, Tex., improvement of	233			1922			
Cedar Keys, Fla., Boat or Number Four Channel north and west of, examination of	195			1676			
Cedar Keys, Fla., harbor at, improvement of	193			1661			
Cedar River Harbor, Mich., improvement of	318				2525		
Cerulius (schooner), removal of wreck of	32	610					
Champlain, Lake, Narrows of, N. Y. and Vt., improvement of	387						2937
Champlin Creek, N. Y., examination of	94	942					
Channel between Staten Island and New Jersey, improvement of	98		986				
Channel in Back Cove, Portland, Me., improvement of	27	597					
Channel in connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo, examination of	362						2810
Channel north and west of Cedar Keys, Fla., examination of	195			1676			
Charleston and South Side Bridge Company, bridge of, across Great Kanawha River, W. Va.	429						
Charleston Harbor, S. C., construction of casemate at	6						
Charleston Harbor, S. C., improvement of	175		1467				
Charleston Harbor, S. C., removal of wreck in South Channel across bar	178		1487				
Charleston, W. Va., bridging Great Kanawha River at	429						
Charlevoix Harbor, Mich., improvement of	336					2672	
Charlevoix, Mich., bridging Pine Lake near	432						
Charlotte Harbor, Fla., examination of	196			1681			
Charlotte Harbor, Fla., improvement of	190			1646			
Charlotte Harbor, N. Y., improvement of	378					2899	
Charts of northern and northwestern lakes, printing and distribution of	445						3027
Chatham Harbor, Mass., improvement of	46	667					
Chattahoochee River, Ga. and Ala., between West Point and Franklin, examination of	211			1756			
Chattahoochee River, Ga. and Ala., improvement of	199			1702			
Chattanooga, Tenn., and foot of Bee Tree Shoals, Ala., Tennessee River between, improvement of	286				2303		

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Chattanooga, Tenn., Tennessee River above, improvement of	278			2252		
Chattanooga, Tenn., Tennessee River below, improvement of	287			2311		
Cheat River, W. Va., improvement of	291			2361		
Cheboygan Harbor, Mich., improvement of	348				2764	
Chefuncte River, La., improvement of	222		1818			
Chehalis River, Wash., below Montesano, examination and survey of	411				3297	
Chehalis River, Wash., between Aberdeen and Cosmopolis, bridging	430					
Chehalis River, Wash., improvement of	407				3236	
Chenton Inlet, Cape Charles City Harbor, Va., and approaches by, improvement of	130		1199			
Cherrystone Inlet, Cape Charles City Harbor, Va., and approaches by, improvement of	130		1199			
Chesapeake Bay, harbor of refuge at Lynnhaven Bay, foot of, Va., examination and survey for	146					
Chesapeake Bay, removal of wreck in			1201			
Chester River, Md., from Crumpton to Jones Landing, improvement of	126		1188			
Chester River, Md., removal of wreck in Jackson Creek	131		1201			
Chevreuil, Bayou, La., examination of	229			1841		
Chicago and North Michigan Railroad Company, bridge of, across Pine Lake, Mich.	432					
Chicago and North-Western Railway Company, bridges of, across Chicago River, Ill.	432					
Chicago Harbor, Ill., establishment of harbor lines in	18	426		2661		
Chicago Harbor, Ill., improvement of	329			2596		
Chicago, Ill., bridge of city of, obstructing Chicago River at Canal street	436					3861
Chicago, Ill., bridging North Branch of Chicago River near Kinzie street	432					
Chicago, Ill., ship channel in connecting waters of the Great Lakes between, Duluth, and Buffalo, examination of	362				2810	
Chicago River, Ill., at Canal street, Chicago, bridge obstructing	436					3861
Chicago River, Ill., near Kinzie street, Chicago, bridging North Branch of	432					
Chickahominy River, Va., between Holly Landing and Long Bridge, examination of	153	1305				
Chickahominy River, Va., improvement of	149	1299				
Chickasahay River, Miss., improvement of	218		1791			
Chief of Engineers, office of the	451					
Chincoteague Bay, Va., and Delaware Bay, at or near Lewes, Del., water way between, improvement of	123	1168				
Chippewa River, Wis., including Yellow Banks, improvement of	270			2201		
Chippewa River, Wis., survey for reservoirs at sources of				2214		
Chitto, Bogue, La., improvement of	220		1800			
Choctawhatchee River, Fla. and Ala., improvement of	201		1707			
Choptank River, Md., improvement of	127	1189				
Christians Point, West Galveston Bay, Tex., from, examination and survey of	235					
Clackamas Rapids, Oregon, Willamette River at, examination and survey of	421					
Clarendon, Ark., and Lower White River, examination and survey of	257					
Clark Fork of Columbia River, Wash., Idaho, and Mont., between international boundary line and mouth of Big Blackfoot River, examination of	409				3250	
Clark River, S. C., improvement of	172	1453				
Clarke, Lewis and, River, Oregon, examination and survey for snagging	421				3383	
Clay County, Mo., bridging Missouri River at	432					
Clearwater River, Idaho, about 11 miles above Lewiston, bridging	431					
Cleveland Harbor, Ohio, improvement of	370				2853	
Clinch River, Tenn., improvement of	281			2264		
Clinton and Illinois Bridge Company, bridge of, across Mississippi River at Clinton, Iowa	428					

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Clinton Harbor, Conn., improvement of.....	66 759					
Clinton, Iowa, bars north of Little Rock Island, in Mississippi River near, examination and survey for removal of	267			2187		
Clinton, Iowa, bridging Mississippi River near	428					
Clinton River, Mich., improvement of.....	358				2788	
Clubfoot River, N. C., improvement of.....		1363				
Coal Bank Slough, Coos County, Oregon, bridging.....	432					
Coanjok Bay, N. C., improvement of	152	1305				
Coaster Harbor Island, R. I., cove and water way near, improvement of.....	57 718					
Cocheco River, N. H., improvement of	31 607					
Cocodrie, Bayou, St. Landry Parish, La., examination of.....	229		1849			
Collins Crossing, N.C., and Roberts Landing, N. C., White Oak River between, examination of.....	170	1434				
Colorado River, Ariz., between Yuma and Eldorado Canyon, examination of.....	393				2974	
Colorado River, Tex., examination for removal of raft at mouth of.....	235		1939			
Columbia, Department of the, report of acting engineer officer on operations in.....	450					3045
Columbia, La., bridging Ouachita River near	430					
Columbia River, Oregon and Wash.:						
Bridging, near Vancouver, Wash.....	429					
Construction of canal at Cascades, Oregon	414				3328	
Examination and survey of, between mouth of Willamette River, Oregon, and Vancouver, Wash.....	421					
Examination and survey of Columbia and Willamette rivers below Portland, Oregon.....	421					
Examination of, between Astoria and Woods Landing, Oregon, for snagging.	420				3380	
Examination of channel from, to head of Youngs Bay, Oregon	420				3376	
Examination of Clark Fork of, Wash., Idaho, and Mont., between international boundary line and mouth of Big Blackfoot River.....	409				3250	
Gauging	419				3372	
Improvement of, between head of Rock Island Rapids and foot of Priest Rapids.	406				3223	
Improvement of Columbia and Willamette rivers below Portland, Oregon..	416				3362	
Improvement of mouth of	412				3314	
Improvement of Upper Columbia River.	405				3210	
Removal of wreck in.....	420				3373	
Columbus, Miss., and Demopolis, Ala., Tombigbee River between, improvement of....	215		1783			
Columbus (tug), wreck of.....			1605			
Commission on survey of Wilmington Harbor, Del	120	1138				
Commission on valuation of channel constructed by Buffalo Bayou Ship Channel Company in Galveston Bay, Tex.....	233		1906 1910			
Compton Creek and Shoal Harbor, N. J., improvement of	105	1004				
Conecuh River, Ala., improvement of	203		1735			
Congaree River, S. C., improvement of	174	1464				
Conneaut Harbor, Ohio, examination and survey of	373					
Connecticut River above Hartford, Conn., improvement of	64 748					
Connecticut River below Hartford, Conn., examination of.....	79 80 836					
Connecticut River below Hartford, Conn., improvement of.....	65 750					
Contentnia Creek, N. C., improvement of...	158	1351				
Contingencies of rivers and harbors, examinations, surveys and, estimates for	421					
Coos Bay and Harbor, Oregon, entrance to, improvement of	401				3154	
Coos Bay, Oregon, examination and survey of upper harbor	410				3283	
Coos Bay, Roseburg and Eastern Railroad and Navigation Company, bridge of, across Coal Bank Slough, Oregon	432					
Coos County, Oregon, bridging Coal Bank Slough	432					

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Coosa River between Rome, Ga., and East Tennessee, Virginia and Georgia Railroad Bridge, improvement of	208		1745			
Coosa River between Wetumpka, Ala., and East Tennessee, Virginia and Georgia Railroad Bridge, improvement of	208		1748			
Coosa River, Ga. and Ala., improvement of	207		1743			
Coosa River, Ga. and Ala., operating and care of canals and other works of navigation on	210		1753			
Coquille City, Oregon, and Myrtle Point, Coquille River between, examination and survey of	410				3275	
Coquille River, Oregon, between Coquille City and Myrtle Point, examination and survey of	410				3275	
Coquille River, Oregon, improvement of	399				3146	
Cornwall, N. Y., Moodna River (Murderers Creek) and Hudson River at, examination and survey of	94	944				
Corps of Engineers, battalion of	15	540				
Corps of Engineers, laws of Fifty-first Congress, second session, affecting	477					
Corps of Engineers, officers of	3					
Corps of Engineers, recommendations as to examinations for promotion of officers of	4					
Corps of Engineers, statement showing rank and duties of officers of	453					
Corsica Shoal, Mich., at lower end of Lake Huron, near St. Clair River, examination of	363				2820	
Corvallis, Oregon, Willamette River near, examination and survey of	421					
Cos Cob or Miamus River, Conn., examination and survey of	81	852				
Cosmopolis, Wash., bridging Chehalis River at	430					
Cottonport, La., to Atchafalaya River, Bayou des Glaises from, examination of	230			1854		
Council Bluffs, Iowa, bridging Missouri River at	431					
Courtableau, Bayou, La., improvement of	225			1826		
Courtland, Va., Nottoway River below, examination of	153		1315			
Cove near Coaster Harbor Island, R. I., improvement of	57	718				
Covington, Ga., to Ocmulgee River, Yellow River from, examination of	184			1606		
Cowlitz River, Wash., improvement of	418					3370
Crane Creek, Va., examination of	146		1289			
Creel Bay, Devil Lake, N. Dak., examination of	274				2223	
Crooked River, Wash., examination of	420					3378
Crookston, Minn., Red River of the North and tributaries above, examination and survey of	274					
Cross-over Light and Sister islands, N. Y., shoal in St. Lawrence River between, improvement of	383					2922
Crumpton, Md., and Jones Landing, Chester River between, improvement of	126		1188			
Cumberland River, Tenn. and Ky.:						
Improvement of	282				2267	
Improvement of, above mouth of Jellico Creek, Ky	284				2275	
Improvement of, above Nashville, Tenn.	283				2270	
Improvement of, below Nashville, Tenn.	282				2268	
Improvement of South Fork of, Ky	285				2286	
Cumberland Sound, Ga. and Fla,, improvement of	184			1559		
Current River below Van Buren, Mo., examination of	257				2065	
Currituck Sound, N. C., improvement of	152		1305			
Currituck Sound, N. C., water way between Norfolk Harbor, Va., and Albemarle Sound, N. C., through, improvement of	151		1302			
Curtis Bay, Patapsco River, Md., from Craighill channel to sugar refinery wharves at, examination of	135		1243			
Cuttyhunk and Neshawana islands, Mass., Canapitsit Channel, between, examination and survey of	62					
Cypress Bayou and lakes between Jefferson, Tex., and Shreveport, La., survey of	248				2021	

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
D.						
Dallas, Tex., Trinity River below, examination of	235		1936			
Dam, Allegheny River, Pa., at Herr Island, construction of	292			2366		
Dam, Ohio River, at Davis Island, operating and care of	290			2350		
Dam, Ohio River, near mouth of Beaver River, Pa., construction of	290			2354		
Dams and locks. (*See* Locks and Dams.)						
Daniels Creek and Tuscaloosa, Ala., Black Warrior River between, improvement of	215		1784			
D'Arbonne, Bayou, La., improvement of	240			1980		
Dardanelle, Ark., bridging Arkansas River at	430					
Darien Harbor, Ga., improvement of	180		1528			
Davids Island, N. Y., sea wall and embankment at	6 9 521					
Davis Island Dam, Ohio River, operating and care of	290			2350		
Débris, mining, question in California, investigation of	399				2996	
Deep River, Wash., examination of	420				3378	
Deep-water harbor on Pacific coast between Points Duma and Capistrano, Cal., examination for	394					
De Grasse, Sylvia (ship), removal of wreck of	420				3373	
Delaware Bay:						
Construction of iron pier near Lewes, Del	114		1073			
Examination for harbor of refuge for deep-draft vessels near mouth of	119		1120			
Improvement of ice-harbor at head of, Del	113		1072			
Improvement of water way between Chincoteague Bay, Va., and, at or near Lewes, Del	123		1168			
Removal of wrecks in	118		1090			
Delaware Breakwater, Del., harbor at, improvement of	115		1075			
Delaware River at Philadelphia, Pa., and Camden, N. J., establishment of harbor lines in	425		1121			
Delaware River, Pa. and N. J., improvement of	108		1022			
Delaware River, removal of wrecks from	118		1090			
Demopolis, Ala., and Columbus, Miss., Tombigbee River between, improvement of	215			1783		
Demopolis, Ala., Tombigbee River below, improvement of	214			1783		
Department of the Columbia, report of acting engineer officer on operations in	450					3045
Department of the Platte, report of acting engineer officer on operations in	450					3046
Departments, military, estimates for surveys and reconnaissances in	450					
Departments, military, reconnaissances and explorations in	449					3043
Depot, engineer	16 547					
Des Allemands, Lake, La., and points near Vacherie, etc., bayous Chevreuil and Tigre between, examination of	229			1841		
Des Chutes River, Wash., Olympia Harbor to mouth of, examination and survey of	411					
Des Glaises, Bayou, La., from Atchafalaya River to Cottonport, examination of	230			1854		
Des Moines Rapids and Illinois River, Mississippi River between, improvement of	263			2119		
Des Moines Rapids and Minneapolis, Mississippi River between, improvement of	265			2147		
Des Moines Rapids canal and dry dock, operating and care of	266			2174		
Des Moines Rapids, Mississippi River, improvement of	266			2172		
Detroit River, Mich., American channel of, examination of	362				2808	
Detroit River, Mich., improvement of	361				2793	
Devil Lake, N. Dak., examination of	274			2223		
Dickinson, Frederick W., *et al.*, bridge of, in Barnstable, Mass	431					
Distribution of charts of northern and northwestern lakes	445					3027

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
District of Columbia, improvement and care of public buildings and grounds	444					3907
District of Columbia, water supply of	441					3897
Division engineers	19					
Division of the Missouri, report of engineer officer on operations in	449					3943
Division of the Pacific, report of acting engineer officer on operations in	450					3947
Divisions, Engineer	19					
Divisions, military, reconnaissances and explorations in	449					3943
Doboy and Sapelo, Ga., inside route between, examination and survey of	185					
Double Bayou, Chambers County, Tex., mouth of, examination of	235		1933			
Dozier Bridge, Va., West Neck River to and beyond, examination of	153		1324			
Drum Inlet, N. C., examination of	170		1425			
Dry dock at St. Marys Falls Canal, Mich	346					2758
Dry dock, Des Moines Rapids, operating and care of	266			2174		
Dublin, Ga., bridging Oconee River near	429	430				
Duck Creek, Del. (*See* Smyrna River.)						
Duck Island Harbor, Conn., improvement of	66	757				
Duluth Harbor, Minn., and adjacent waters, establishment of harbor lines in	18	426		2515		
Duluth Harbor, Minn., improvement of	311			2488		
Duluth, Minn., ship channel in connecting waters of the Great Lakes, between, Chicago and Buffalo, examination of	362					2810
Duma, Point, and Point Capistrano, Cal., deep-water harbor on Pacific coast between, examination for	394					
Duncan Falls, Ohio, bridge obstructing Muskingum River at	434					
Dunkirk Harbor, N. Y., improvement of	374					2878
Duties of officers of Corps of Engineers, statement showing	453					
Duwamish River, Wash., examination of	409					3257
Duwamish River, Wash., near Seattle, bridging	431					
D'Wamish River, Wash., examination of	409					3257
D'Wamish River, Wash., near Seattle, bridging	431					
E.						
Eagle Harbor, Mich., improvement of	315			2505		
East Chester Creek, N. Y., improvement of	75	806				
East Omaha, Nebr., bridging Missouri River at	431					
East River, N. Y., establishment of harbor lines in	425	963				
East River, N. Y., removing obstructions from	86	899				
East Tennessee, Virginia and Georgia Railway bridge and Rome, Ga., Coosa River between, improvement of	208			1745		
East Tennessee, Virginia and Georgia Railway bridge and Wetumpka, Ala., Coosa River between, improvement of	208			1748		
East Tennessee, Virginia and Georgia Railway Company, bridge of, obstructing Tennessee River	435					
Eastern Branch of Elizabeth River and Lynn Haven Bay, Va., water way between, examination of	153		1310			
Eastern Branch of Potomac River, D. C., examination and survey of	146					
Eastern Branch of Potomac River, D. C., improvement of	135		1246			
Echo Harbor, New Rochelle, N. Y., improvement of	74	802				
Edgartown, Mass., Marthas Vineyard, inner harbor at, improvement of	49	698				
Edinburg and Carthage, Miss., Pearl River between, improvement of	220			1799		
Edisto River, S. C., improvement of	177		1480			
Edward J. Gay (steamboat), removal of wreck of	231			1869		
Effingham County, Ga., bridging Savannah River in	429					
Eldorado Canyon and Yuma, Ariz., Colorado River between, examination of	393					2974

Subject.	Page. Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Elizabeth River, N. J., improvement of	100	993				
Elizabeth River, Va., Eastern Branch of, and Lynn Haven Bay, Va., water way between, examination of	153	1310				
Elizabeth River, Va., Western Branch of, examination of	153	1307				
Elizabethport, N. J., removal of wreck at	107	1013				
Elk River, Md., improvement of	125	1184				
Elk River, W. Va., examination for improvement of, by locks and dams	303			2433		
Elk River, W. Va., improvement of	300			2427		
Elk River, W. Va., obstructions in						3867
Ellen, Mary (schooner), removal of wreck of		1201				
Engineer Depot	16 547					
Engineer Divisions	19					
Engineer School, United States	15 539					
Engineers, Battalion of	15 540					
Engineers, Chief of, office of the	451					
Engineers, Corps of, laws of Fifty-first Congress, second session, affecting	477					
Engineers, Corps of, officers of	3					
Engineers, Corps of, recommendations as to examinations for promotion of officers of	4					
Engineers, Corps of, statement showing rank and duties of officers of	453					
Engineers, Division	19					
Engineers, The Board of	11					
Erie Harbor, Pa., improvement of	373				2869	
Erie Harbor, Pa., Presque Isle Peninsula, preservation and protection of	374				2877	
Escambia River, Fla., improvement of	203		1735			
Essex River, Mass., examination and survey of	47 676					
Evansville, Ind., and mouth of Green River, Ky., Ohio River between, examination of	294			2382		
Examinations and surveys	17					
Examinations for promotion of officers of Corps of Engineers, recommendations as to	4					
Examinations, surveys, and contingencies of rivers and harbors, estimates for	421					
Explorations	449					
Explosives, tests of	550 559					
F.						
Fairlee Creek, Md., improvement of	126	1186				
Fairport Harbor, Ohio, improvement of	371				2859	
Falia, Bogue, La., improvement of	222		1818			
Falls of Ohio River, Indiana Chute, improvement of	296			2393		
Falls of Ohio River, Louisville, Ky., improvement of	295			2387		
Falls of St. Anthony, Minn., Mississippi River above, improvement of	268			2192		
Farmer, Ky., and West Liberty, Licking River between, improvement of	306			2462		
Feather River, Cal., Board on improvement of	396				2990	
Feather River, Cal., improvement of	396				2987	
Feather River, Cal., investigation of mining-débris question	399				2996	
Fergus Falls, Minn., Red River of the North and tributaries above, examination and survey of	274					
Fernandina, Fla., and Savannah, Ga., inside route between, examination and survey of	185					
Fishing Creek, N. C., improvement of	156	1345				
Fishways at Great Falls, Potomac River, erection of	443					3905
Five Mile River Harbor, Conn., improvement of	72 792					
Flint River, Ga., improvement of	198		1698			
Florence, Ala., bridge obstructing Tennessee River at	435					
Florida Central and Peninsular Railroad Company, bridge of, obstructing Trout Creek, Fla	435					
Flushing Bay, N. Y., improvement of	77 822					
Fond du Lac, Minn., and Grassy Point, St. Louis River between, examination and survey of	317					
Forked Deer River, Tenn., improvement of	246			2012		

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Forster, Frederick P., *et al.*, bridge of, in Barnstable, Mass	431					
Fort Benton, Mont., and Sioux City, Iowa, Missouri River between, examination and survey of	277			2242		
Fort Marion, Fla., repair and preservation of	6 11 533					
Fort Monroe, Va., beach protection, water supply, and sewerage system at	10 529					
Fort Niagara, N. Y., protection of site of	8 517					
Fortifications	4					
Fortifications, estimates of appropriations for 1892–'93	11					
Fortifications, protection, preservation, and repair of	6					
Fortifications, sites for	5					
Fourche River, Ark., improvement of	251			2044		
Fox River, Wis., improvement of	328			2572		
Fox River, Wis., operating and care of locks and dams on	329			2580		
Francis E. Hallock (schooner), removal of wreck of	93 937					
Frankfort Harbor, Mich., improvement of	337				2674	
Frankfort, Ky., bridge obstructing Kentucky River at	436					
Franklin, Ala., and West Point, Ga., Chattahoochee River between, examination of	211		1756			
French Broad River, Tenn., improvement of	280			2261		
Fulton, Ark., Red River above, improvement of	237			1961		
Fulton County, Ky., and Lake County, Tenn., Mississippi River between, examination of	258			2073		
Fulton, Miss., and Vienna, Ala., Tombigbee River between, improvement of	213		1780			
Fulton, Miss., and Walker Bridge, Miss., Tombigbee River between, improvement of	213		1779			
G.						
Galleries, cable, construction of	6					
Galveston Bay, Tex., ship channel in, improvement of	232		1906			
Galveston Bay, Tex., valuation of channel constructed by Buffalo Bayou Ship Channel Company in	233		1906 1910			
Galveston Harbor, Tex., entrance to, improvement of	231		1871			
Galveston (West) Bay, Tex., from Christians Point, for reopening channel through West Bay, examination and survey of	235					
Gartside, Benjamin (schooner), removal of wreck of	61 731					
Gasconade River, Mo., improvement of	261			2112		
Gauging Columbia River, Oregon and Wash.	419				3372	
Gauging Mississippi River and its principal tributaries	246			2014		
Gauging Mississippi River at or near St. Paul, Minn	273			2214		
Gauley River, W. Va., improvement of	301			2428		
Gay, Edward J. (steamboat), removal of wreck of	231		1869			
Gay Head Light, removal of wreck near	61 732					
Gen. W. T. Sherman (schooner), removal of wreck of	118	1090				
General Lee (steamer), removal of wreck of	184		1602			
Georgetown Harbor, S. C., improvement of	168	1408				
Gilchrist, Leo (elevator), removal of wreck of	231		1869			
Glaises, Bayou des, La., from Atchafalaya River to Cottonport, examination of	230		1854			
Glen Cove Harbor, N. Y., improvement of	77 820					
Gloucester Harbor, Mass., improvement of	36 635					
Goat Island, Newport Harbor, R. I., examination of spit at south end of	62 736					
Golden Eagle (schooner), removal of wreck of	32 610					
Goose Rapids, Red River of the North, Minn. and N. Dak., examination for construction of lock and dam	274			2220		
Gordon Landing, Lake Champlain, Vt., breakwater at	385				2930	
Goshen Creek, N. J., examination and survey of	119	1116				
Governors Island, N. Y., sea walls at	6 9 524					

Subject.	Page. Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Gowanus Bay channel, New York Harbor, N. Y., examination of	93 937					
Gowanus Bay, N. Y., improvement of	89 914					
Grand Haven Harbor, Mich., improvement of	340				2692	
Grand Lake, La., course of Mermenton River through, examination and survey of	230		1858			
Grand Marais, Mich., harbor of refuge at, improvement of	316			2509		
Grand Marais, Minn., harbor at, improvement of	310			2484		
Grand Rapids, Mich., Grand River below, examination and survey of	345					
Grand River, Mich., below Grand Rapids, examination and survey of	345					
Grand River, Ohio, below Richmond, examination and survey of	373					
Grand Trunk Railway Company, bridge of, obstructing channel to Back Cove, Portland, Me	435					
Grass River, N. Y., improvement of	384				2926	
Grassy Point, Minn., and Fond du Lac, St. Louis River between, examination and survey of	317					
Grays Harbor and Bar, Wash., examination and survey of	411				3297	
Grays Harbor, Wash., bridging Johns River near confluence with	430					
Grays River, Wash., examination and survey of	421				3385	
Great Bay, N. J., examination for harbor of refuge	118	1095				
Great Bay, N. J., north of Atlantic City and Cape May, thoroughfare between, examination of	118	1097				
Great Chazy River, N. Y., improvement of	385				2929	
Great Egg Harbor Bay and Barnegat Bay, N. J., sound between, examination of	118	1093				
Great Falls, Mont., and canyon next below Stubbs Ferry, Missouri River between, examination and survey of	278					
Great Falls, Mont., and Sioux City, Iowa, Missouri River between, improvement of	275			2232		
Great Falls, Potomac River, erection of fishways at	443					3905
Great Kanawha River, W. Va., at Charleston, bridging	429					
Great Kanawha River, W. Va., deposit of refuse in						3866
Great Kanawha River, W. Va., improvement of	299			2413		
Great Kanawha River, W. Va., operating and care of locks and dams on	300			2425		
Great Lakes, printing and distribution of charts of	445					3927
Great Lakes, ship channel in connecting waters of the, between Chicago, Duluth, and Buffalo, examination of	362				2810	
Great Lakes, survey of	445					3927
Great Pedee River, S. C., improvement of	172	1450				
Great Sodus Bay, N. Y., harbor at, improvement of	380				2906	
Great Wicomico River, Va., examination of	146	1288				
Green Bay Harbor, Wis., improvement of	320			2533		
Green Jacket Shoal, Providence River, R. I., removal of	55 715					
Green, Maria (schooner), removal of wreck of	131	1201				
Green River, Ky., above mouth of Big Barren River, examination of	310			2478		
Green River, Ky. (below Lock No. 1), at Spottsville, bridge obstructing	434					
Green River, Ky., mouth of, and Evansville, Ind., Ohio River between, examination of	294			2382		
Green River, Ky., operating and keeping in repair locks and dams on	304			2439		
Greenbrier River, W. Va., and Wilson Creek, Va., New River between mouths of, improvement of	302			2430		
Greenport Harbor, N. Y., improvement of	75 811					
Greenwich Bay, R. I., improvement of	56 716					
Grosse Pointe Channel, Mich., improvement of	359				2790	

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Grounds, public, D. C., improvement and care of	444					3007
Gunter Creek at Guntersville, Ala., examination of	288			2325		
Guntersville, Ala., Gunter Creek at, examination of	288			2325		
Guyandotte River, W. Va., improvement of	308			2469		
H.						
Habersham (steamer), removal of wreck of	184			1602		
Hackensack, N. J., and Newark Bay, Hackensack River between, examination and survey of	107		1016			
Hackensack River, N. J., examination and survey of	107		1016			
Half-Moon Reef, Aransas Bay, Tex., examination for removal of	235			1942		
Hallock, Francis E. (schooner), removal of wreck of	93	937				
Hamilton, Ill., slough in Mississippi River at, examination of	267				2185	
Hampton Creek and Bar, Va., improvement of	148		1297			
Hampton Roads, Va., construction of casemate at	6					
Hampton Roads, Va., defense of	5	8				
Handkerchief light-ship, removal of wreck near	61	731				
Harbor and river improvements	17					
Harbor lines, establishment of	18	423				
At Duluth, Minn., St. Louis Bay, Superior Bay, and adjacent waters, Minn. and Wis	18	426			2515	
At Lubec, Me	18	424 621				
At New Castle, Del	18	425	1225			
At San Pedro, Wilmington Harbor, Cal	18	426				2976
In Astoria Harbor, Oregon	18	427				3387
In Boston Harbor, Mass	18	424 688				
In Chicago Harbor, Ill	18	426			2661	
In Humboldt Bay, Cal	18	427				3138
In Kennebec River at Bath, Me	18	424 622				
In New York Harbor and adjacent waters	18	424 958				
In port of Philadelphia, Pa	18	425	1121			
In Portage Lake, Mich	18	316			2519	
	317	426				
In St. Augustine Harbor, Fla	18	425		1685		
In San Francisco Harbor and adjacent waters, Cal	18	426				2948
Harbor lines in Portage Lake, Mich., resurvey and relocation of	316	317			2522	
Harbors and rivers, examinations, surveys, and contingencies of, estimates for	421					
Harbors of refuge:						
At Block Island, R. I	59	723				
At entrance of Sturgeon Bay Canal, Wis.	321				2536	
At Grand Marais, Mich	316				2509	
At Hyannis, Mass	48	694				
At Little Harbor, N. H	31	608				
At Lynnhaven Bay, Va., examination and survey for	146					
At Milwaukee Bay, Wis	325				2553	
At Nantucket, Mass	48	696				
At Point Judith, R. I	58	722				
At Portage Lake, Mich	337					2676
At Sand Beach, Lake Huron, Mich	353					2776
At Sandy Bay, Cape Ann, Mass	36	632				
At Stonington, Conn	60	728				
Near mouth of Delaware Bay, examination for	119		1120			
Harlem River, N. Y., at 155th street and McComb Dam Road, New York City, bridging	432					
Harlem River, N. Y., improvement of	84	886				
Harlowe River, N. C., improvement of			1363			
Harmar, Ohio, bridge obstructing Muskingum River at	434					
Harraseeket River, Me., improvement of	26	594				
Hartford, Conn., Connecticut River above, improvement of	64	748				
Hartford, Conn., Connecticut River below, examination of	79 80	836				
Hartford, Conn., Connecticut River below, improvement of	65	750				

Subject.	Page. Part I.		Part II.	Part III.	Part IV.	Part V.	Part VI.
Havre de Grace, Md., Susquehanna River above and below, improvement of	124		1181				
Havre de Grace, Md., Susquehanna River above, examination and survey of	132						
Hay Lake Channel, St. Marys River, Mich., improvement of	347					2758	
Hell Gate and East River, N. Y., removing obstructions from	86	899					
Herr Island Dam, Allegheny River, Pa., construction of	292				2266		
Hiawassee River, Tenn., improvement of	280				2259		
Hingham Harbor, Mass., improvement of	42			1656			
Holland Harbor, Mich., improvement of	341					2696	
Holly Landing and Long Bridge, Va., Chickahominy River between, examination of	153		1305				
Holmes River, Fla., improvement of	200			1704			
Houma, La., and Thibodeaux, Bayou Terre Bonne between, examination of	229			1843			
Housatonic River, Conn., improvement of	69	773					
Houston, Central Arkansas and Northern Railroad Company, bridge of, across Little River, La	429						
Houston, Central Arkansas and Northern Railroad Company, bridge of, across Ouachita River, La	430						
Houston, Central Arkansas and Northern Railroad Company, bridge of, across Red River, La	430						
Hudson Harbor, Wis., examination of	274				2218		
Hudson River, N. Y., at Moodna River (Murderers Creek), Cornwall, examination and survey of	94	944					
Hudson River, N. Y., at New York City, bridging	433						3853
Hudson River, N. Y., Board on improvement of	82	866					
Hudson River, N. Y., improvement of	81	864					
Hudson River, N. Y., licenses for use of piers, etc., in							3865
Humboldt Bay, Cal., establishment of harbor lines in	18	427				3138	
Humboldt Harbor and Bay, Cal., improvement of	397					3120	
Huntington Bridge, Idaho, and Seven Devils Mining District, Upper Snake River between, examination and survey of	411					3285	
Huntington Harbor, N. Y., improvement of	76	817					
Huron Harbor, Ohio, improvement of	367					2843	
Huron, Lake, Corsica Shoal, Mich., at lower end of, examination of	363					2820	
Huron, Lake, harbor of refuge at Sand Beach, Mich	353					2776	
Hyannis, Mass., harbor of refuge at	48	694					
Hyannis, Mass., removal of wreck in harbor at	62	732					
I.							
Ice-harbors:							
At head of Delaware Bay, Del	113		1072				
At Marcus Hook, Pa	113		1072				
At mouth of Muskingum River, Ohio	293				2367		
At New Castle, Del	120		1160				
Illinois and Mississippi Canal, construction of	334				2633		
Illinois River, Ill.:							
Examination and survey of, below La Salle	335				2658		
Improvement of	332				2611		
Improvement of Mississippi River between Des Moines Rapids and	263				2119		
Improvement of Mississippi River between Ohio River and	259				2087		
Operating and care of La Grange Lock	333				2630		
Increasing water supply of Washington, D. C	442						3904
Indian River, Fla., between Titusville and Jupiter Inlet, examination of	195			1673			
Indiana Chute, Falls of Ohio River, improvement of	296				2393		
Injury to and occupancy of public works by corporations or individuals	19	436					3865
Inspection of improvement of South Pass of Mississippi River	19	221		1805			

Subject.	Page. Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Inter-State Bridge and Street Railway Company, bridge of, across Missouri River at Council Bluffs, Iowa	431					
Ipswich River, Mass., improvement of	35 631					
Isle Marthe (ship), removal of wreck of	231		1869			
J.						
Jackson Creek, Chester River, Md., removal of wreck in	131	1201				
Jackson, Miss., and Carthage, Miss., Pearl River between, improvement of	220		1797			
Jackson, Miss., Pearl River below, improvement of	219		1795			
Jacksonville and Sanford, Fla., St. Johns River between, examination of	195		1666			
Jamaica Bay and Long Beach Inlet, N. Y., water way between, examination and survey of	94					
James River, Va., improvement of	134	1234				
Jefferson, Tex., and Shreveport, La., Cypress Bayou and the lakes between, survey of	248			2021		
Jekyl Creek, Ga., improvement of	183		1556			
Jellico Creek, Ky., Cumberland River above mouth of, improvement of	284			2275		
Johns River, Wash., near confluence with Grays Harbor, bridging	430					
Jones Landing, Md., and Crumpton, Chester River between, improvement of	126	1188				
Josiah Whitehouse (schooner), removal of wreck of	61 732					
Jupiter Inlet and Titusville, Fla., Indian River between, examination of	195		1673			
K.						
Kansas City, bridging Missouri River about 8.6 miles above	430					
Kansas City Terminal Railway Company, bridge of, across Missouri River near Quindaro, Kans	430					
Kansas River, Kans., bridging Missouri River near mouth of	432					
Karquines Strait, Cal., modification of harbor lines on south shore of	426				2948	
Karquines Strait, Cal., survey of	389				2947	
Kaskaskia River, Ill., improvement of	263			2118		
Kennebec River, Me., at Bath, establishment of harbor lines in	18 424 622					
Kennebec River, Me., from Waterville to Augusta, examination and survey of	33					
Kennebec River, Me., improvement of	26 590					
Kennebunk River, Me., improvement of	29 601					
Kenosha Harbor, Wis., improvement of	326			2565		
Kentucky River, Ky., at Frankfort, bridge obstructing	436					
Kentucky River, Ky., improvement of	305			2449		
Kentucky River, Ky., operating and keeping in repair locks and dams on	306			2455		
Kewaunee Harbor, Wis., improvement of	322			2540		
Keweenaw Bay and Portage Lake, Mich., purchase of canal between	17					
Keweenaw Point, Mich., purchase of canals across	17					
Key West Harbor, Fla., northwest entrance, improvement of	188		1640			
Keyport Harbor, N. J., improvement of	104	1001				
Kingston Harbor, Mass., examination and survey of	47 685					
Kingstree, S. C., Black River below, examination of	170	1435				
Klaskuine River, Wash., improvement of	419				3371	
L.						
La Fayette, Ind., and Terre Haute, Wabash River between, examination of	298			2411		
La Fourche, Bayou, La., improvement of	224		1821			
La Grange Bayou, Fla., improvement of	200		1704			
La Grange Lock, Illinois River, Ill., operating and care of	333			2630		

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Lake Arthur, La., course of Mermenton River through, examination and survey of.	230		1858			
Lake Champlain, Narrows of, N. Y. and Vt., improvement of	387				2037	
Lake County, Tenn., and Fulton County, Ky., Mississippi River between, examination of	258			2073		
Lake des Allemands, La., and points near Vacherie, etc., bayous Chevreuil and Tigre between, examination of	229		1841			
Lake Huron, Corsica Shoal, Mich., at lower end of, examination of	363				2820	
Lake Huron, harbor of refuge at Sand Beach, Mich	353				2776	
Lake Monroe, Fla., St. Johns River above, examination of	195		1666			
Lake Pontchartrain, La., shoals in, near Rigolets, examination of	229		1839			
Lake Samamish, Wash., ship canal to connect Puget Sound with, examination for	412					
Lake Superior, purchase of canals connecting Portage Lake, Mich., with	17					
Lake Superior Ship Canal Railway and Iron Company Canal, purchase of	17					
Lake Union, Wash., ship canal to connect Puget Sound with, examination for	412					
Lake Washington, Wash., ship canal to connect Puget Sound with, examination for	412					
Lakes, Great, ship channel in connecting waters of the, between Chicago, Duluth, and Buffalo, examination of	362				2810	
Lakes, northern and northwestern, printing and distribution of charts of	445					3927
Lakes, northern and northwestern, survey of	445					3927
Larchmont Harbor, N. Y., improvement of	74	800				
La Salle, Ill., Illinois River below, examination and survey of	335			2658		
La Trappe River, Md., examination and survey of	132		1215			
Laws of Fifty-first Congress, second session, affecting Corps of Engineers	477					
Leaf River, Miss., improvement of	218		1792			
Leavenworth and Platte County Bridge Company, bridge of, across Missouri River at Leavenworth, Kans	428					
Leavenworth, Kans., bridging Missouri River at	428					
Leavenworth, Kans., Missouri River from old mouth of Platte River, Little Point, to a point opposite, examination of	275			2229		
Lee, General (steamer), removal of wreck of.	184		1602			
Lee Slough, Fla., improvement of	197		1696			
Leo Gilchrist (elevator), removal of wreck of.	231		1869			
Levisa Fork, Big Sandy River, Ky., improvement of	307			2466		
Lewes, Del., construction of iron pier in Delaware Bay near	114		1073			
Lewes, Del., Delaware Bay at or near, and Chincoteague Bay, Va., water way between, improvement of	123		1168			
Lewis and Clarke River, Oregon, examination and survey for snagging	421				3383	
Lewiston, Idaho, bridging Clearwater River about 11 miles above	431					
Licking River, Ky., between Farmer and West Liberty, improvement of	306			2462		
Linchester River, Md., examination of	131		1202			
Little Egg Harbor Bay and Inlet, N. J., examination for harbor of refuge at	118		1095			
Little Harbor, N. H., harbor of refuge at	31	608				
Little Island, Mass., bridging channel between mainland at Osterville and, Barnstable, Mass	431					
Little Kanawha River, W. Va., improvement of	308			2471		
Little Narragansett Bay, Watch Hill Cove, R. I., examination of	62	735				
Little Pedee River, S. C., improvement of	171		1448			
Little Pigeon River, Tenn., below Sevierville, examination of	285			2287		
Little Platte River, Mo., old mouth of, to a point opposite Leavenworth, Missouri River from, examination of	275			2229		

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Little Point, Missouri River from old mouth of Platte River at, to a point opposite Leavenworth, examination of	275			2229		
Little Red River, Ark., improvement of	254			2053		
Little River, La., bridging	429					
Little River, Mo. and Ark., improvement of	256			2064		
Little Rock Island, Mississippi River, near Clinton, Iowa, examination and survey for removal of bars north of	267			2187		
Little Sodus Bay, N. Y., harbor at, improvement of	380				2909	
Little Tennessee River, near Niles Ferry, Tenn., bridge obstructing	435					
Locks and dams:						
Coosa River, Ga. and Ala., operating and care of locks and dams, etc., on	210		1753			
Fox River, Wis., operating and care of locks and dams on	329			2580		
Great Kanawha River, W. Va., operating and care of locks and dams on	300			2425		
Green and Barren rivers, Ky., operating and keeping in repair locks and dams on	304			2439		
Illinois River, Ill., operating and care of La Grange Lock	333			2630		
Kentucky River, Ky., operating and keeping in repair locks and dams on	306			2455		
Monongahela River, operating and care of locks and dams Nos. 8 and 9	291			2357		
Monongahela River, purchase of Lock and Dam No. 7	291			2359		
Monongahela River, purchase of Lock and Dam No. 6	291			2360		
Muskingum River, Ohio, operating and care of locks and dams on	293			2369		
Lockwood's Folly River, N. C., improvement of	167	1402				
Long Beach Inlet and Jamaica Bay, N. Y., water way between, examination and survey of	94					
Long Bridge and Holly Landing, Va., Chickahominy River between, examination of	153		1305			
Louisville and Nashville Railroad Company, bridge of, obstructing Kentucky River, Ky	436					
Louisville and Portland Canal, Ky., operating and care of	296			2394		
Louisville, Ky., Falls of Ohio River at, improvement of	295			2387		
Louisville, St. Louis and Texas Railroad Company, bridge of, obstructing Green River, Ky	434					
Lower Willamette River, Oregon, below Portland, improvement of	416				3362	
Lubec Channel, Me., examination of	33	616				
Lubec Channel, Me., improvement of	19	571				
Lubec, Me., establishment of harbor lines at	18	424 621				
Ludington Harbor, Mich., improvement of	338				2682	
Lumber River, N. C. and S. C., improvement of	171		1445			
Lynn Harbor, Mass., improvement of	39	641				
Lynn Haven Bay and eastern branch of Elizabeth River, Va., water way between, examination of	153		1310			
Lynn Haven Bay, near Cape Henry, at foot of Chesapeake Bay, Va., examination and survey for harbor of refuge at	146					
M.						
Machodoc Creek, Upper, Va., examination of	146		1286			
Mackey Creek, N. C., improvement of	155		1339			
Maçon, Bayou, La., improvement of	241				1983	
Macon, Dublin and Savannah Railroad Company, bridge of, across Oconee River, Ga	430					
Malden River, Mass., examination of	47	672				
Manasquan (Squan) River, N. J., improvement of	106		1010			
Manatee River, Fla., improvement of	191			1653		
Manchac, Bayou, La., improvement of	223			1820		
Manchester Harbor, Mass., improvement of	37	638				
Manistee Harbor, Mich., improvement of	338				2678	

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Manistique Harbor, Mich., improvement of.	317			2523		
Manitowoc Harbor, Wis., improvement of..	323			2515		
Manokin River, Md., improvement of	129	1195				
Maps, estimates for publication of.....	450					
Maps, military and other.....	449					
Marcus Hook, Pa., ice-harbor at, improvement of	113	1072				
Maria Green (schooner), removal of wreck of.	131	1201				
Marietta and North Georgia Railway Company, bridge of, obstructing Little Tennessee River	435					
Marietta, Ohio, bridge obstructing Muskingum River at	434					
Marion, Fort, Fla., repair and preservation of.....	6 11 533					
Marquette Harbor, Mich., improvement of..	315			2505		
Marquette Harbor, Mich., survey at.....	445					3927
Marthas Vineyard, inner harbor at Edgartown, Mass., improvement of	49 698					
Marthas Vineyard, Menemsha Bight, Mass., examination and survey of	62					
Mary Ellen (schooner), removal of wreck of.		1201				
Mary H. Rhoades (schooner), removal of wreck of.....	131	1201				
Mattaponi River, Va., improvement of	144	1273				
Mattawan Creek, N. J., improvement of....	104	1003				
Mattituck Bay, Suffolk County, N. Y., examination for breakwater at.....	80 843					
Maurice River, N. J., improvement of.....	117	1088				
May, Cape. (*See* Cape May.)						
McComb Dam Bridge, New York, N. Y., bridge to replace	432					
McKeesport, Pa., bridging Youghiogheny River at	431					
McMinnville, Oregon, Yamhill River below, examination and survey of.....	421				3381	
Mediator (steamer), removal of wreck of....	118	1090				
Memphis Harbor, Tenn., examination of....	258					3587
Menemsha Bight, Marthas Vineyard, Mass., examination and survey of.....	62					
Menomonee Harbor, Mich. and Wis., improvement of.....	318			2527		
Menomonee River, Mich. and Wis., improvement of	318			2528		
Mermenton River, La., and tributaries, examination and survey of	230		1858			
Merrimac River, Mass., improvement of....	34 628					
M. E. Tremble (schooner), removal of wreck of.....	361				2801	
Miamus River, Conn., examination and survey of	81 852					
Michigan City Harbor, Ind., improvement of.	344				2706	
Miles City, Mont., Tongue River near, examination of	277			2237		
Milford Harbor, Conn., improvement of.....	69 770					
Military departments, estimates for surveys and reconnaissances in.....	450					
Military divisions and departments, reconnaissances and explorations in.....	449					3043
Military maps	449					
Milwaukee Bay, Wis., harbor of refuge at ..	325			2553		
Milwaukee Harbor, Wis., improvement of..	325			2560		
Mingo Creek, S. C., improvement of.....	173	1455				
Mining-débris question in California, investigation of.....	399				2996	
Minneapolis, Minn., and Des Moines Rapids, Mississippi River between, improvement of	265			2147		
Minnesota Point, at Superior, Wis., improvement of	313			2499		
Minnesota River, Minn., improvement of...	271			2207		
Minnewauken Shoals, Devil Lake, N. Dak., examination of.....	274			2223		
Mispillion Creek, Del., improvement of	122	1166				
Mispillion River, Del., examination and survey of	132					
Mississippi Canal, Illinois and, construction of.....	334			2633		
Mississippi River:						
Bridging, at Alton, Ill	432					
Bridging, at St. Paul, Minn	430					
Bridging, at Winona, Minn	427 431					
Bridging, near Clinton, Iowa.....	428					

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Mississippi River—Continued.						
Examination and survey for removal of bars north of Little Rock Island, near Clinton, Iowa	267			2187		
Examination and survey to determine effect of back water at Clarendon, Ark., and Lower White River	257					
Examination of, at Memphis Harbor, Tenn	258					3587
Examination of, at Warsaw, Ill	264			2134		
Examination of, from Lake County, Tenn., to Fulton County, Ky., north and west of Reelfoot Lake	258			2073		
Examination of slough at Hamilton, Ill	267			2185		
Gauging, and its principal tributaries	246			2014		
Gauging, at or near St. Paul, Minn	273			2214		
Improvement of, above Falls of St. Anthony, Minn	268			2192		
Improvement of, between Des Moines Rapids and Illinois River	263			2119		
Improvement of, between Minneapolis and Des Moines Rapids	265			2147		
Improvement of, between Ohio and Illinois rivers	259			2087		
Improvement of Des Moines Rapids	266			2172		
Improvement of, etc., between Ohio River and Head of the Passes (report of Mississippi River Commission)	422					3397
Inspection of improvement of South Pass of	19	221		1805		
Operating snag boats and dredge boats on Upper	264			2137		
Removing snags and wrecks from	258			2079		
Reopening Willow Slough, or some other channel from Quincy Bay to				2124		
Reservoirs at headwaters of	268			2196		
Survey for reservoirs at sources of				2214		
Mississippi River Commission, report of	422					3397
Missouri, Division of the, report of engineer officer on operations in	449					3943
Missouri River:						
Bridging, between Council Bluffs, Iowa, and East Omaha, Nebr	431					
Bridging, between Leavenworth, Kans., and Platte County, Mo	428					
Bridging, near mouth of Kansas River, between Wyandotte County, Kans., and Clay County, Mo	432					
Bridging, near Quindaro, Kans., abont 8.6 miles above Kansas City	430					
Examination and survey of, between canyon next below Stubbs Ferry and Great Falls, Mont	278					
Examination and survey of, between mouth of Big Sioux River and north line of South Dakota	277			2242		
Examination and survey of, between Sioux City, Iowa, and Fort Benton, Mont	277			2242		
Examination of, at Weston, Mo	275			2229		
Examination of, from old mouth of Platte River, Little Point, to point opposite Leavenworth, Kans	275			2229		
Improvement of, between Great Falls, Mont., and Sioux City, Iowa	275			2232		
Improvement of, etc. (report of Missouri River Commission)	423					3723
Missouri River and Land Improvement and Construction Company, bridge of, across Missouri River near mouth of Kansas River	432					
Missouri River Commission, report of	423					3723
Mobile Harbor, Ala., improvement of	211		1771			
Mokelumne River, Cal., examination and survey of	399				3133	
Mokelumne River, Cal., improvement of	395				2986	
Monongahela River, W. Va. and Pa.:						
Bridging, near Pittsburg	432					
Improvement of	290			2355		
Operating and care of Locks and Dams Nos. 8 and 9	291			2357		
Purchase of Lock and Dam No. 7	291			2359		
Purchase of Lock and Dam No. 6	291			2360		

Subject.	Page. Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Monroe, Fort, Va., beach protection, water supply, and sewerage system at	10 529					
Monroe Harbor, Mich., improvement of	363				2825	
Monroe, Lake, Fla., St. Johns River above, examination of	195		1666			
Montesano, Wash., Chehalis River below, examination and survey of	411				3297	
Monument, Washington, Washington, D. C., maintenance of	444					3907
Moodna River, N. Y., examination and survey of	94 944					
Mooseabec Bar, Me., improvement of	20 572					
Mount Desert to Porcupine Island, Me., breakwater from	21 576					
Mount Vernon, Va., Potomac River at, improvement of	138	1252				
Moyock, N. C., North-West River below, examination of	153	1321				
Murderers Creek, N. Y., examination and survey of	94 944					
Murderkill River, Del., examination and survey of	132					
Murphy, John H., *et al.*, bridge of, in Barnstable, Mass	431					
Muscle Shoals Canal, Tennessee River, operating and care of	287			2322		
Muskegon Harbor, Mich., improvement of	340				2689	
Muskingum County, Ohio, bridges of commissioners of, obstructing Muskingum River	434					
Muskingum River, Ohio:						
Bridge obstructing, between Marietta and Harmar	434					
Bridge obstructing, between Taylorsville and Duncan Falls	434					
Bridge obstructing canal of, at foot of Main street, Zanesville	434					
Ice-harbor at mouth of	293			2367		
Improvement of	293			2369		
Operating and care of locks and dams on	293			2369		
Myrtle Point, Oregon, and Coquille City, Coquille River between, examination and survey of	410				3275	
Mystic River, Conn., improvement of	63 740					
Mystic River, Mass., examination and survey of	47 672					
N.						
Nandua Creek, Va., examination of	146	1283				
Nansemond River, Va., improvement of	148	1298				
Nanticoke River, Md., northwest fork of, examination of	131	1204				
Nantucket, Mass., harbor of refuge at	48 696					
Napa River, Cal., improvement of	389				2952	
Narragansett Bay, R. I., channel between Starve Goat Island and mainland, examination of	62 733					
Narragansett Bay, R. I., construction of casemates for defense of	6					
Narragansett Bay, R. I., improvement of	54 712					
Narraguagus River, Me., improvement of	21 574					
Narrows of Lake Champlain, N. Y. and Vt., improvement of	387				2937	
Nasel River, Wash., examination and survey of	411				3294	
Nashville (steamer), wreck of			1605			
Nashville, Tenn., Cumberland River above, improvement of	283			2270		
Nashville, Tenn., Cumberland River below, improvement of	282			2268		
Neches River, Tex., improvement of	228		1836			
Nehalem Bay, Oregon, improvement of	405				3205	
Nellie (barge), removal of wreck of	107	1013				
Nemadji River, at Superior, Wis., examination of	316			2512		
Neshawana and Cuttyhunk islands, Mass., Canapitsit Channel, between, examination and survey of	62					
Neuse River, N. C., improvement of	159	1358				
New Bedford Harbor, Mass., improvement of	51 704					

Subject.	Page. Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
New Berne and Beaufort, N. C., water way between, improvement of	160	1363				
New Bridge Company, bridge of, obstructing Ashley River, S. C	433					
New Castle, Del., establishment of harbor lines at	18 425	1225				
New Castle, Del., ice-harbor at, improvement of	120	1160				
New Haven, Conn., breakwater at	68 766					
New Haven Harbor, Conn., improvement of	67 761					
New London Harbor, Conn., examination of Shaw Cove	79 833					
New London Harbor, Conn., improvement of	64 746					
New Orleans Harbor, La., removal of wrecks in	231		1869			
New River, N. C., and Beaufort Harbor, N. C., water way between, improvement of	162	1372				
New River, N. C., and Swansboro, N. C., water way between, improvement of	162	1376				
New River, N. C., improvement of	163	1379				
New River, Va. and W. Va., improvement of	302			2430		
New Rochelle Harbor, N. Y., improvement of	74 804					
New Rochelle, N. Y., Echo Harbor, improvement of	74 802					
New York Central and Hudson River Railroad Company, bridge of, obstructing Spuyten Duyvil Creek, N. Y	435					
New York Harbor, N. Y.:						
Construction of casemates at	6					
Defense of	5 7					
Establishment of harbor lines in, and adjacent waters	18 {424 958}					
Examination of Bay Ridge Channel	94 940					
Examination of Buttermilk and Gowanus Bay channels	93 937					
Improvement of	90 922					
Improvement of Bay Ridge Channel	90 917					
Improvement of Buttermilk Channel	88 911					
Improvement of Gowanus Bay	89 914					
Removal of wreck in	93 937					
Supervision of	422				3393	
New York, N. Y., bridge of commissioners of public parks of city of, across Harlem River at 155th street and McComb Dam Road	432					
New York, N. Y., bridging Hudson River at	433					3853
Newark Bay, N. J., and Hackensack, N. J., Hackensack River between, examination and survey of	107	1016				
Newark, N. J., Passaic River above, improvement of	100	990				
Newark, N. J., Passaic River below, improvement of	99	988				
Newburyport Harbor, Mass., improvement of	33 626					
Newport Creek, head of Wicomico River, Md., examination of	146	1281				
Newport Harbor, R. I., improvement of	57 719					
Newport Harbor, R. I., south of Goat Island, examination of	62 736					
Newport River, N. C., improvement of		1363				
Newtown Creek, N. Y., establishment of harbor lines in	424 961					
Newtown Creek, N. Y., improvement of	87 906					
Niagara Falls, N. Y., Port Day above, examination and survey of	378					
Niagara, Fort, N. Y., protection of site of	8 517					
Niagara River, N. Y., improvement of	376					2888
Niles Ferry, Tenn., bridge obstructing Little Tennessee River near	435					
Nomini Creek, Va., improvement of	140	1259				
Nooksack River, Wash., examination of	410					3271
Nootsack River, Wash., improvement of	408					3238
Norfolk and Western Railroad Company, bridges of, across Tug Fork of Big Sandy River	431					
Norfolk Harbor, Va., and Albemarle Sound, N. C., water way between, improvement of	151	1302				
Norfolk Harbor, Va., improvement of	146	1291				
Norfolk Harbor, Va., improvement of approaches to	146 147	1291 1296				

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
North East (Cape Fear) River, N. C., improvement of	164	1383				
North East River, Md., improvement of	124	1182				
North Landing River, Va. and N. C., improvement of	151	1304				
North River Bar, N. C., improvement of	152	1305				
North River Bridge Company, bridge of, across Hudson River at New York City	433					3853
North River, Mass., at Salem, examination of	46 668					
North River, Mass., shoals at mouth of, examination of	46 670					
North River, Wash., examination and survey of	409				3263	
North-West River, N. C., below Moyock, examination of	153	1321				
Northern and northwestern lakes, printing and distribution of charts of	445					3927
Northern and northwestern lakes, ship channel in connecting waters of, between Chicago, Duluth, and Buffalo, examination of	362				2810	
Northern and northwestern lakes, survey of	445					3927
Northern Pacific and Puget Sound Shore Railroad Company, bridge of, across Duwamish River, Wash	431					
Northwestern and northern lakes, printing and distribution of charts of	445					3927
Northwestern and northern lakes, ship channel in connecting waters of, between Chicago, Duluth, and Buffalo, examination of	362				2810	
Northwestern and northern lakes, survey of	445					3927
Norwalk Harbor, Conn., improvement of	71 786					
Nottoway River, Va., below Courtland, examination of	153	1315				
Noxubee River, Miss., improvement of	217		1787			
O.						
Oak Bay and Port Townsend Bay, Puget Sound, Wash., examination for ship channel between	409				3260	
Oak Orchard Harbor, N. Y., improvement of	377				2896	
Oakland Harbor, Cal., improvement of	388				2943	
Obion River, Tenn., examination and survey of	285			2292		
Occoquan Creek, Va., improvement of	138	1253				
Occupancy of and injury to public works by corporations or individuals	19 436					3865
Ocklawaha River, Fla., improvement of	186		1620			
Ocmulgee River, Ga., improvement of	182		1543			
Ocmulgee River, Ga., to Covington, Yellow River from, examination of	184		1606			
Oconee River, Ga., improvement of	181		1536			
Oconee River, Ga., near Dublin, bridging	429 430					
Oconto Harbor, Wis., improvement of	319			2531		
Ocracoke Inlet, N. C., improvement of	156	1341				
Office of the Chief of Engineers	451					
Officers of Corps of Engineers	3					
Officers of Corps of Engineers, recommendations as to examinations for promotion of	4					
Officers of Corps of Engineers, statement showing rank and duties of	453					
Ogdensburg Harbor, N. Y., improvement of	383				2923	
Ogeechee River, Ga., wrecks in			1605			
Ohio River:						
Construction of movable dam near mouth of Beaver River, Pa	290			2354		
Examination of, at Owensboro, Ky	294			2380		
Examination of, between mouth of Green River, Ky., and Evansville, Ind.	294			2382		
Improvement of	288			2328		
Improvement of Falls of, Louisville, Ky.	295			2387		
Improvement of Indiana Chute, Falls of	296			2393		
Improvement of Mississippi River below, etc. (report of Mississippi River Commission)	422					3397
Improvement of Mississippi River between Illinois River and	259			2087		
Operating and care of Davis Island Dam	290			2350		
Operating snag boats on	290			2349		
Olcott Harbor, N. Y., improvement of	377				2893	
Olympia Harbor, Wash., examination and survey of	411					

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Omaha, Nebr., bridging Missouri River at East	431					
Onancock Harbor, Va., improvement of	129	1197				
Ontonagon Harbor, Mich., improvement of	314			2502		
Oregon Railway Extensions Company, bridge of, across Columbia River near Vancouver, Wash	429					
Osage River, Mo., improvement of	262			2114		
Osterville, Barnstable, Mass., bridging channel between Little Island and mainland at	431					
Oswego Harbor, N. Y., improvement of	381				2912	
Otter Creek, Vt., improvement of	386				2935	
Ouachita River above Camden, Ark., improvement of	239			1975		
Ouachita River, Ark. and La., improvement of	238			1964		
Ouachita River, La., near Columbia, bridging	430					
Owensboro Harbor, Ky., Ohio River, examination of	294			2380		
P.						
Pacific coast, deep-water harbor between Points Duma and Capistrano, Cal., on, examination for	394					
Pacific, Division of the, report of acting engineer officer on operations in	450					3947
Paddy Ryan (scow), removal of wreck of		1090				
Padilla Bay, Wash., and Skagit Bay, water way through Swinomish Slough connecting, examination and survey of	411					
Pamlico River, N. C., and Bay River, N. C., water way between, examination of	170	1421				
Pamlico River, N. C., at Washington Harbor, examination of	170	1429				
Pamlico River, N. C., improvement of	157	1347				
Pamlico River, N. C., opposite Swan Point, removal of wreck in	169	1417				
Pamunkey River, Va., improvement of	145	1275				
Pascagoula River, Miss., improvement of	217			1788		
Pasquotank River, N. C., improvement of	155	1335				
Passaic River, N. J., above Newark, improvement of	100	990				
Passaic River, N. J., below Newark, improvement of	99	988				
Passaic River, N. J., improvement of	99	988				
Patapsco River, Md., from Craighill Channel to sugar refinery wharves, Curtis Bay, examination of	135	1243				
Patapsco River, Md., improvement of	132	1227				
Patchogue River, N. Y., improvement of	78	825				
Patuxent River, Md., improvement of	141	1262				
Pawcatuck River, R. I. and Conn., improvement of	60	726				
Pawtucket River, R. I., improvement of	54	709				
Peace River, Fla. (*See* Pease River.)						
Pearl River, Miss., below Jackson, improvement of	219			1795		
Pearl River, Miss., between Edinburg and Carthage, improvement of	220			1799		
Pearl River, Miss., between Jackson and Carthage, improvement of	220			1797		
Pease Creek, Fla., improvement of	190			1646		
Pease River, Fla., examination of	195			1678		
Peconic River, Suffolk County, N. Y., examination and survey of	81	855				
Penobscot River, Me., examination and survey of	33					
Penobscot River, Me., improvement of	23	579				
Pensacola Harbor, Fla., improvement of	202			1710		
Pensaukee Harbor, Wis., improvement of	319				2533	
Pensauken Creek, N. J., examination of	118		1100			
Pentwater Harbor, Mich., improvement of	339					2684
Pepperell Cove, Me., examination of	32	614				
Petaluma Creek, Cal., improvement of	397					3119
Petit Jean River, Ark., improvement of	252				2046	
Petoskey Harbor, Mich., improvement of	336					2670
Philadelphia Harbor, Pa., construction of casemates at	6					
Philadelphia Harbor, Pa., improvement of	110		1029			
Philadelphia, Pa., establishment of harbor lines in port of	18	425	1121			

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Pier in Delaware Bay, near Lewes, Del., construction of	114	1073				
Piers, etc., occupancy of and injury to, by corporations or individuals	19 436					3865
Pine Lake, Mich., entrance to, improvement of	336				2672	
Pine Lake, Mich., near Charlevoix, bridging	432					
Piscataway Creek, Md., examination of	145	1279				
Piscataway Creek, Va., examination of	146	1289				
Pittsburg, Pa., bridging Allegheny River at Sixth street	431					
Pittsburg, Pa., bridging Monongahela River near	432					
Plaquemine, Bayou, La., bridge obstructing	434					
Plaquemine, Bayou, La., improvement of	225		1824			
Plaquemine, Bayou, La., securing mouth of, from further caving	231		1867			
Platte County, Mo., bridging Missouri River at	428					
Platte, Department of the, report of acting engineer officer on operations in	450					3040
Platte River (Little), Mo., old mouth of, to a point opposite Leavenworth, Kans., Missouri River from, examination of	275			2229		
Plattsburg Harbor, N. Y., improvement of	385				2931	
Plattsburg, N. Y., inner bay near mouth of Saranac River at, examination of	388				2938	
Pleasant River, Me., improvement of	20 573					
Pleasant River, Me., removal of wrecks in	32 610					
Plymouth Harbor, Mass., improvement of	44 660					
Point Judith, R. I., harbor of refuge at	58 722					
Points Duma and Capistrano, Cal., deep-water harbor on Pacific coast between, examination for	394					
Pollock Rip Shoals, Mass., removal of wreck at	61 731					
Pontchartrain, Lake, La., shoals in, near Rigolets, examination of	229		1839			
Porcupine Island, Me., breakwater from Mount Desert to	21 576					
Port Barre, La., and St. Martinsville, Bayou Teche between, examination of	230		1852			
Port Chester Harbor, N. Y., improvement of	73 797					
Port Clinton Harbor, Ohio, improvement of	365				2835	
Port Costa, Cal., modification of harbor lines at	426				2948	
Port Day, N. Y., above Niagara Falls, examination and survey of	378					
Port Huron, Mich., Black River at, improvement of	354				2780	
Port Jefferson Inlet, harbor at, N. Y., improvement of	76 814					
Port Orford Harbor, Oregon, reëxamination of	411				3305	
Port Royal and Augusta Railway Company, bridge of, obstructing Savannah River, Ga	435					
Port Townsend Bay and Oak Bay, Puget Sound, Wash., examination for ship channel between	409				3260	
Port View Bridge Company, bridge of, across Youghiogheny River, Pa	431					
Port Washington Harbor, Wis., improvement of	324			2551		
Portage Lake and River Improvement Company Canal, purchase of	17					
Portage Lake, Mich., harbor of refuge at	337				2676	
Portage Lake, Mich. (Houghton County), establishment of harbor lines in	18 316 317 426			2519		
Portage Lake, Mich. (Houghton County), purchase of canals between, and Keweenaw Bay and Lake Superior, Mich	17					
Portage Lake, Mich. (Houghton County), resurvey and relocation of harbor line in	316 317			2522		
Portage River, Mich., purchase of water way along	17					
Portland Canal, Louisville and, Ky., operating and care of	296			2394		
Portland Harbor, Me., construction of casemate at	6					
Portland Harbor, Me., improvement of	27 595					
Portland Harbor, Me., removal of wreck from	32 609					

Subject.	Page.											
	Part I.		Part II.		Part III.		Part IV.		Part V.		Part VI.	
Portland, Me., bridge obstructing channel to Back Cove	435											
Portland, Me., improvement of channel in Back Cove	27	597										
Portland, Oregon, Columbia and Willamette rivers below, examination and survey of	421											
Portland, Oregon, Columbia and Willamette rivers below, improvement of	416								3362			
Portland, Oregon, Willamette River above, improvement of	417								3368			
Portsmouth Harbor, N. H., improvement of	30	604										
Post of Willets Point, N. Y	15	537										
Potomac Creek, Va., examination of	146		1285									
Potomac River:												
Erection of fish ways at Great Falls	443										3905	
Examination and survey of, below Washington, D. C	146											
Examination and survey of Eastern Branch of, D. C	146											
Improvement of, at Mount Vernon, Va	138		1252									
Improvement of, at Washington, D. C	135		1246									
Improvement of Eastern Branch of, D. C	135		1246									
Powow River, Mass., bridge across	427											
Powow River, Mass., improvement of	35	630										
Presque Isle Peninsula, Erie Harbor, Pa., preservation and protection of	374								2877			
Priest Rapids, Wash., foot of, and head of Rock Island Rapids, Columbia River between, improvement of	406								3223			
Princess Bay, Staten Island, N. Y., examination of	107		1013									
Printing and distribution of charts of northern and northwestern lakes	445										3927	
Promotion of officers of Corps of Engineers, recommendations as to examinations for	4											
Providence River, R. I., improvement of	54	712										
Providence River, R. I., removal of Green Jacket Shoal	55	715										
Provincetown Harbor, Mass., improvement of	45	665										
Public buildings and grounds, D. C., improvement and care of	444										3907	
Public works, occupancy of and injury to, by corporations or individuals	19	436									3865	
Publication of maps, estimates for	450											
Puget Sound, Wash., ship canal to connect Lakes Union, Washington, and Samamish with, examination for	412											
Puget Sound, Wash., ship channel between Port Townsend Bay and Oak Bay, examination for	409								3260			
Puget Sound, Wash., water way through Swinomish Slough connecting Saratoga Passage and Skagit Bay with Padilla Bay, examination and survey of	411											
Pultneyville Harbor, N. Y., improvement of	379								2903			
Pungo River to Sladesville, N. C., water way from, examination of	170		1418									
Puyallup River, Wash., examination of	409								3255			
Q.												
Quincy Bay, Ill., reopening Willow Slough, or some other channel, from Mississippi River to							2124					
Quindaro, Kans., bridging Missouri River near	430											
R.												
Racine Harbor, Wis., improvement of	326						2562					
Rahway River, N. J., improvement of	101		995									
Rancocas River, N. J., improvement of	116		1084									
Rancocas River, N. J., removal of wreck in			1090									
Rank and duties of officers of Corps of Engineers, statement showing	453											
Rappahannock River, Va., improvement of	142		1264									
Raritan Bay, N. J., improvement of	92	931										
Raritan Bay, N. J., removal of wreck in	93	937										
Raritan River, N. J., establishment of harbor lines in	424	960										

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Raritan River, N. J., improvement of	102	996				
Reconnaissances	449					
Reconnaissances in military departments, estimates for	450					
Red River above Fulton, Ark., improvement of	237			1961		
Red River, La. and Ark., improvement of	236			1946		
Red River, La., at Upper Falls, near Alexandria, bridging	430					
Red River of the North, Minn. and N. Dak., and tributaries above Fergus Falls and Crookston, and Big Stone Lake, examination and survey of	274					
Red River of the North, Minn. and N. Dak., at Goose Rapids, examination for construction of lock and dam	274			2220		
Red River of the North, Minn. and N. Dak., improvement of	272			2210		
Redondo Beach Harbor, Cal., examination of	393				2972	
Redwood Creek, Cal., examination of	393				2966	
Redwood Creek, Cal., improvement of	390				2953	
Redwood Harbor, Cal., improvement of	390				2953	
Reelfoot Lake, Tenn., Mississippi River north and west of, examination of	258			2073		
Reservoirs at headwaters of Mississippi River	268			2196		
Reservoirs at sources of Mississippi, St. Croix, Chippewa, and Wisconsin rivers, surveys for				2214		
Rhoades, Mary H. (schooner), removal of wreck of	131	1201				
Richmond, Ohio, Grand River below, examination and survey of	373					
River and harbor improvements	17					
Rivers and harbors, examinations, surveys, and contingencies of, estimates for	421					
Roads in Yellowstone National Park, construction and improvement of	447					3931
Roanoke River, Va. and N. C., improvement of	154	1330				
Roberts Landing and Collins Crossing, N. C., White Oak River between, examination of	170		1434			
Rock Hall Harbor, Md., examination and survey of	132					
Rock Island Rapids, Wash., head of, and foot of Priest Rapids, Columbia River between, improvement of	406					3223
Rockland Harbor, Me., improvement of	25	589				
Rockport Harbor, Me., improvement of	25	588				
Rome, Ga., and East Tennessee, Virginia and Georgia Railroad bridge, Coosa River between, improvement of	208			1745		
Rondeway, Bayou, La., improvement of	242				1992	
Rondout Harbor, N. Y., improvement of	83	882				
Ross Island, Oregon, Willamette River at examination and survey of	421					
Rouge River, Mich., examination for turning basin in	363					2822
Rouge River, Mich., improvement of	360					2791
Rough River, Ky., improvement of	305				2446	
Rouse Point, Lake Champlain, N. Y., breakwater at	384					2927
Russel Fork of Big Sandy River, Ky., examination of	310				2476	
Russell, Annie J. (schooner), removal of wreck of	32	609				
Ryan, Paddy (scow), removal of wreck of			1090			
S.						
Sabine Lake, La. and Tex., and Calcasieu Lake, connection between, via Bayou Black, examination of	230			1850		
Sabine Lake, La. and Tex., and Sudduth Bluff, Sabine River between, examination of	230					
Sabine Pass, Tex., harbor at, improvement of	227			1831		
Sabine River, Tex., between Sabine Lake and Sudduth Bluff, examination of	230					
Sabine River, Tex., improvement of	228			1835		
Sacketts Harbor, N. Y., harbor at, improvement of	382					2918

Subject.	Page.						
	Part I.		Part II.	Part III.	Part IV.	Part V.	Part VI.
Saco River, Me., breakwater at mouth of	28	598					
Saco River, Me., improvement of	28	599					
Sacramento River, Cal., Board on improvement of	396					2990	
Sacramento River, Cal., improvement of	396					2987	
Sacramento River, Cal., investigation of mining-débris question	399					2996	
Sacramento River, Cal., mouth of, survey of	389					2947	
Sag Harbor, Suffolk County, N. Y., examination and survey for breakwater at	81	859					
Saginaw River, Mich., improvement of	351					2772	
Saginaw River, Mich., injury to revetment in							3871
St. Anthony Falls, Minn., Mississippi River above, improvement of	268				2192		
St. Augustine Harbor, Fla., establishment of harbor lines in	18	425		1685			
St. Augustine Harbor, Fla., examination of channel in	195			1671			
St. Augustine Harbor, Fla., improvement of	188			1630			
St. Charles Bay, Tex., examination for removing obstructions at mouth of	235			1942			
St. Clair Flats Canal, Mich., improvement of	356					2784	
St. Clair Flats Canal, Mich., injury to pier at							3872
St. Clair Flats Canal, Mich., operating and care of	358					2787	
St. Clair, Madison and St. Louis Belt Railroad Company, bridge of, across Mississippi River at Alton, Ill.	432						
St. Clair River, Mich., Corsica Shoal in lower end of Lake Huron near, examination of	363					2820	
St. Clair River, Mich., removal of wrecks in	361					2801	
St. Croix Lake, Wis., near Hudson, examination of	274				2218		
St. Croix River, Me., improvement of	19	570					
St. Croix River, Wis. and Minn., improvement of	271				2203		
St. Croix River, Wis. and Minn., survey for reservoirs at sources of					2214		
St. Francis River, Ark., improvement of	255				2059		
St. Francis River, Mo., improvement of	256				2062		
St. Jerome Bay, Md., examination of	145		1278				
St. Johns River, Fla., improvement of	185			1612			
St. Johns River, Fla., upper part of, south of Lake Monroe; and from Jacksonville to Sanford, examination of	195			1666			
St. Jones River, Del., improvement of	122		1165				
St. Joseph Harbor, Mich., improvement of	343					2702	
St. Joseph River, Mich., improvement of	343					2705	
St. Lawrence River, N.Y., shoal between Sister Islands and Cross-over Light in, improvement of	383					2922	
St. Leonard Creek, Md., examination of	145		1277				
St. Louis Bay and adjacent waters, Minn. and Wis., establishment of harbor lines in	18	426			2515		
St. Louis Bay, Wis., and Fond du Lac, Minn., St. Louis River between Grassy Point in, examination and survey of	317						
St. Louis Bay, Wis., improvement of	312				2495		
St. Louis Harbor, Mo., improvement of	260				2109		
St. Louis River, Minn. and Wis., between Fond du Lac and Grassy Point, examination and survey of	317						
St. Martinsville, La., and Port Barre, Bayou Teche between, examination of	230			1852			
St. Marys Falls Canal dry dock, Mich	346					2758	
St. Marys Falls Canal, Mich., occupancy of and injuries to public works, etc., at							3868
St. Marys Falls Canal, Mich., operating and care of	346					2724	
St. Marys River, Mich., Hay Lake Channel, improvement of	347					2758	
St. Marys River, Mich., improvement of	345					2712	
St. Paul, Minn., bridge of city of, across Mississippi River	430						
St. Paul, Minn., gauging Mississippi River at or near	273				2214		
Salamander (schooner), removal of wreck of	93	937					
Salem Harbor, Mass., improvement of	38	639					
Salem, Mass., North River at, examination of	46	668					
Salisbury, Mass., bridge across Powow River at	427						
Salkahatchie River, S. C., improvement of	178		1482				

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Samamish, Lake, Wash., ship canal to connect Puget Sound with, examination for..	412					
San Diego Harbor, Cal., improvement of ...	392				2960	
San Diego Harbor, Cal., occupancy of levee at.....						3873
San Francisco Harbor, Cal., and adjacent waters, establishment of harbor lines in ..	18 426				2948	
San Francisco Harbor, Cal., and adjacent waters, survey of	389				2947	
San Francisco Harbor, Cal., construction of casemates at	6					
San Francisco Harbor, Cal., defense of	5 8					
San Joaquin River, Cal., improvement of...	394				2981	
San Joaquin River, Cal., investigation of mining-débris question	399				2996	
San Joaquin River, Cal., mouth of, survey of.	389				2947	
San Luis Obispo Harbor, Cal., improvement of.....	391				2955	
San Pablo Bay, Cal., survey of	389				2947	
San Pedro, Wilmington Harbor, Cal., establishment of harbor lines at.....	18 426				2976	
San Rafael River, Cal., examination of.....	393				2963	
San Simeon Bay, Cal., examination of	393				2971	
Sand Beach, Lake Huron, Mich., harbor of refuge at.....	353				2776	
Sandusky City Harbor, Ohio, improvement of.	366				2837	
Sandusky River, Ohio, improvement of.....	366				2840	
Sandy Bay, Cape Ann, Mass., harbor of refuge at.....	36 632					
Sanford and Jacksonville, Fla., St. Johns River between, examination of.....	195			1666		
Santa Cruz, Cal., harbor of refuge at, examination of.....	393				2968	
Santee River, S. C., improvement of	173		1458			
Sapelo and Doboy, Ga., inside route between, examination and survey of.....	185					
Saranac River, N. Y., inner bay near mouth of, at Plattsburg, examination of	388				2938	
Sarasota Bay, Fla., improvement of	191			1651		
Saratoga Passage, Wash., and Padilla Bay, water way through Swinomish Slough connecting, examination and survey of....	411					
Saugatuck Harbor, Mich., improvement of.	342				2999	
Saugatuck River, Conn., examination of....	80 840					
Saugerties Harbor, N. Y., improvement of.	82 879					
Savannah, Ga., and Fernandina, Fla., inside route between, examination and survey of.	185					
Savannah River and Harbor, Ga., improvement of.....	179			1491		
Savannah River and Harbor, Ga., removal of wrecks in	184			1602		
Savannah River, Ga., below Augusta, bridge obstructing.....	435					
Savannah River, Ga., improvement of	180			1519		
Savannah River, near Sister Ferry, Effingham County, Ga., bridging.....	429					
Sayville, N. Y., Browns Creek at, improvement of.....	79 828					
Schuylkill River, Pa., improvement of.....	112		1069			
Scituate Harbor, Mass., improvement of....	43 658					
Sea walls and embankments at Davids and Governors islands, New York Harbor	6 9 521 524					
Seattle and Northern Railroad Company, bridge of, obstructing Swinomish Slough, Wash.....	433					
Seattle, Wash., bridging Duwamish River near	431					
Sebewaing, Mich., Sebewaing River below, examination of.....	362				2804	
Sebewaing River, Mich., below Sebewaing, examination of.....	362				2804	
Seven Devils mining district, Idaho, and Huntington Bridge, Upper Snake River between, examination and survey of.....	411				3285	
Sevierville, Tenn., Little Pigeon River below, examination of	285			2287		
Shark River, N. J., examination of	118		1092			
Shaw Cove, New London Harbor, Conn., examination of.....	79 833					
Sheboygan Harbor, Wis., improvement of ..	323			2549		
Sheepshead Bay, N. Y., improvement of.....	96		982			
Sherman, Gen. W. T. (schooner), removal of wreck of.....	118		1090			

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Ship canal connecting Lakes Union, Washington, and Samamish with Puget Sound, Wash., examination for	412					
Ship channel between Port Townsend Bay and Oak Bay, Puget Sound, Wash., examination for	409				3260	
Ship channel in connecting waters of the Great Lakes between Chicago, Duluth, and Buffalo, examination of	362				2810	
Ship channel in Galveston Bay, Tex., improvement of	232		1906			
Ship Island Harbor, Miss., removal of wreck in	228		1837			
Shoal between Sister Islands and Cross-over Light, St. Lawrence River, N. Y., improvement of	383				2922	
Shoal Harbor and Compton Creek, N. J., improvement of	105	1004				
Shoalwater Bay, Wash., examination of	409				3266	
Shreveport, La., and Jefferson, Tex., Cypress Bayou and the lakes between, survey of	248			2021		
Shrewsbury River, N. J., improvement of	106	1007				
Sioux City, Iowa, and Fort Benton, Mont., Missouri River between, examination and survey of	277			2242		
Sioux City, Iowa, and Great Falls, Mont., Missouri River between, improvement of	275			2232		
Sister Ferry, Ga., bridging Savannah River near	429					
Sister Islands and Cross-over Light, N. Y., shoal in St. Lawrence River between, improvement of	383				2922	
Sites for fortifications	5					
Siuslaw River, Oregon, improvement of	402				3173	
Skagit Bay, Wash., and Padilla Bay, water way through Swinomish Slough connecting, examination and survey of	411					
Skagit River, Wash., examination of	410				3271	
Skagit River, Wash., improvement of	408				5238	
Skamokawa River, Wash., examination of	420				3378	
Sladesville, N. C., to Pungo River, water way from, examination of	170	1418				
Smith Creek, Md., examination of	146	1282				
Smithland Harbor, Ky., examination of	285			2289		
Smyrna River, Del., improvement of	121	1162				
Smyrna River, Del., removal of wreck in	131	1201				
Snake River (Upper), Idaho, between Huntington Bridge and Seven Devils mining district, examination and survey of	411				3285	
Snake River, Wash., improvement of	405				3210	
Snohomish River, Wash., examination of	410				3271	
Snohomish River, Wash., improvement of	408				3238	
Snoqualmie River, Wash., improvement of	408				3238	
Sopelo, Ga. (*See* Sapelo.)						
South Bend, Wash., Shoalwater Bay and Willapah River at, examination and survey of	409				3266	
South Bound Railroad Company, bridge of The, across Savannah River, Ga.	429					
South Dakota, north line of, and mouth of Big Sioux River, Missouri River between, examination and survey of	277			2242		
South Fork of Cumberland River, Ky., improvement of	285			2286		
South Haven Harbor, Mich., improvement of	342				2700	
South Pass of Mississippi River, inspection of improvement of	19	221	1805			
South River, N. J., improvement of	103		999			
Spokane and Palouse Railway Company, bridge of, across Clearwater River, Idaho	431					
Spottsville, Ky., bridge obstructing Green River at	434					
Spuyten Duyvil Creek, N. Y., bridge obstructing	435					
Squan River, N. J. (*See* Manasquan River.)						
S. S. Bickmore (schooner), removal of wreck of	62	732				
Stamford Harbor, Conn., examination and survey of	80	848				
Stamford Harbor, Conn., improvement of	72	795				

Subject.	Page. Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Starve Goat Island, R. I., channel between, and mainland, in Narragansett Bay, examination of	62 733					
Staten Island and New Jersey, channel between, improvement of	98	986				
Staten Island, N. Y., Princess Bay, examination of	107	1013				
Staunton River, Va., improvement of	153	1328				
Steele Bayou, Miss., improvement of	244			2005		
Steilaquamish River, Wash., improvement of	408				3238	
Stonington, Conn., harbor of refuge at	60 728					
Stony Creek River, at Stony Creek, Conn., examination of	79 831					
Strait of Karquines, Cal., survey of	389				2947	
Stubbs Ferry, Mont., canyon next below; and Great Falls, Missouri River between, examination and survey of	278					
Sturgeon Bay Canal, Wis., harbor of refuge at entrance of	321			2536		
Sucarnochee River, Ala., examination of	221		1800			
Sudduth Bluff, Tex., and Sabine Lake, Sabine River between, examination of	230					
Suisun Bay, Cal., survey of	389				2947	
Sullivan Falls, Hancock County, Me., examination of	33 619					
Sumpawanus Inlet, N. Y., improvement of	94	978				
Superior Bay and adjacent waters, Minn. and Wis., establishment of harbor lines in	18 426			2515		
Superior Bay, Wis., improvement of	312			2495		
Superior, Lake, purchase of canals connecting Portage Lake, Mich., with	17					
Superior, Wis., Allouez Bay and Nemadji River at, examination of	316			2512		
Superior, Wis., Minnesota Point at, improvement of	313			2499		
Supervision of the harbor of New York	422				3393	
Survey of northern and northwestern lakes.	445					3927
Surveys and examinations	17					
Surveys, examinations, and contingencies of rivers and harbors, estimates for	421					
Surveys in military departments, estimates for	450					
Susquehanna River above and below Havre de Grace, Md., improvement of	124	1181				
Susquehanna River above Havre de Grace, Md., examination and survey of	132					
Susquehanna River, West Branch of, Pa., examination of	118	1102				
Suwanee River, Fla., improvement of	194		1663			
Swan Island, Oregon, Willamette River on west side of, examination of	420				3373	
Swansboro and New River, N. C., water way between, improvement of	162	1376				
Swinomish Slough, Wash., bridge obstructing	433					
Swinomish Slough, Wash., examination and survey of	411					
Sylvia de Grasse (ship), removal of wreck of.	420				3373	
T.						
Tacoma, Olympia and Grays Harbor Railroad Company, bridges of, across Chehalis and Johns rivers, Wash	430					
Tallahatchee River, Miss., improvement of.	244			2003		
Tallapoosa River, Ala., improvement of	206		1741			
Tampa Bay, Fla., improvement of	192		1655			
Tangier Harbor, Va., examination of	131	1207				
Tar River, N. C., improvement of	157	1347				
Taunton River, Mass., improvement of	53 707					
Taylorsville, Ohio, bridge obstructing Muskingum River at	434					
Tchefuncte River, La. (*See* Chefuncte River.)						
Tchula Lake, Miss., improvement of	244			2001		
Teche, Bayou, La., between St. Martinsville and Port Barre, examination of	230		1852			
Teche, Bayou, La., improvement of	226		1828			
Tennessee River:						
Bridge at Florence, Ala., obstructing	435					
Improvement of	278			2252		

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Tennessee River—Continued.						
Improvement of, above Chattanooga, Tenn	278			2252		
Improvement of, below Bee Tree Shoals, Ala	279			2255		
Improvement of, below Chattanooga, Tenn	287			2311		
Improvement of, between Chattanooga, Tenn., and foot of Bee Tree Shoals, Ala.	286			2303		
Operating and care of Muscle Shoals Canal	287			2322		
Tensas River, La., improvement of	241			1989		
Terre Haute, Ind., and La Fayette, Wabash River between, examination of	298			2411		
Terrebonne, Bayou, La., and Bayou Black, examination for connection between	229		1846			
Terrebonne, Bayou, La., between Houma and Thibodeaux, examination of	229		1843			
Terrebonne, Bayou, La., improvement of	224		1823			
Texas and Pacific Railway Company, bridge of, obstructing Bayou Plaquemine, La	434					
Thames River, Conn., improvement of	63	742				
The Board of Engineers	11					
The South Bound Railroad Company, bridge of, across Savannah River, Ga	429					
The Upper Bridge Company, bridge of, across Monongahela River, Pa	432					
Thibodeaux, La., and Houma, Bayou Terrebonne between, examination of	229		1843			
Thoroughfare from Cape May to Great Bay north of Atlantic City, N. J., examination of	118		1097			
Thunder Bay Harbor, Mich., improvement of	348				2765	
Thunder Bay River, Mich., improvement of	350				2768	
Tickfaw River, La., and its tributaries, improvement of	222		1819			
Ticonderoga River, N. Y., improvement of	387				2936	
Tigre, Bayou, La., examination of	229		1841			
Tillamook Bay and Bar, Oregon, examination and survey of	411					
Tillamook Bay and Bar, Oregon, improvement of	404				3200	
Tionesta Creek, Pa., between Tionesta and Balltown, examination of	294			2381		
Tionesta, Pa., and Balltown, Tionesta Creek between, examination of	294			2381		
Titusville and Jupiter Inlet, Fla., Indian River between, examination of	195		1673			
Toledo Harbor, Ohio, improvement of	364				2828	
Tombigbee River, improvement of:						
Below Demopolis, Ala	214		1783			
Below Vienna, Ala	214		1781			
Between Demopolis, Ala., and Columbus, Miss	215		1783			
Between Fulton, Miss., and Vienna, Ala.	213		1780			
Between Walker Bridge and Fulton, Miss	213		1779			
Toms River, N. J., examination and survey of	119	1114				
Tonawanda Harbor, N. Y., improvement of	376				2834	
Tongue River, Mont., near Miles City, examination of	277			2237		
Tongue River, Mont., Yellowstone River below mouth of, examination of	277			2239		
Torpedo experiments	550					
Torpedoes for harbor defense	552					
Totten Bay, Devil Lake, N. Dak., examination of	274			2223		
Town River, Mass., examination and survey of	47	679				
Tradewater River, Ky., improvement of	304			2438		
Tremble, M. E. (schooner), removal of wreck of	361				2801	
Trent River, N. C., improvement of	158		1355			
Trinity River, Tex., below Dallas, examination of	235		1936			
Trinity River, Tex., improvement of	233		1918			
Trout Creek, Fla., bridge obstructing	435					
Tug Fork, Big Sandy River, 91 and 95½ miles above Catlettsburg, Ky., bridging	431					
Tug Fork, Big Sandy River, W. Va. and Ky., improvement of	303			2467		

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Tumwater, Wash., Olympia Harbor to, examination and survey of	411					
Turner Creek, Md., examination and survey of	132	1211				
Tuscaloosa and Daniels Creek, Ala., Black Warrior River between, improvement of	215		1784			
Two Rivers Harbor, Wis., improvement of	322			2343		
U.						
Umpqua River, Oregon, improvement of	402				3160	
Union, Lake, Wash., ship canal to connect Puget Sound with, examination for	412					
United States Engineer School	15	539				
Upper Bridge Company, bridge of The, across Monongahela River, Pa	432					
Upper Columbia River, Oregon and Wash., improvement of	405				3210	
Upper Falls, La., bridging Red River at	430					
Upper Machodoc Creek, Va., examination of	146		1286			
Upper Mississippi River, operating snag boats and dredge boats on	264			2137		
Upper Snake River, Idaho, between Huntington Bridge and Seven Devils mining district, examination and survey of	411				3285	
Urbana Creek, Va., improvement of	142		1268			
Use of public works by corporations or individuals	19	436				3865
V.						
Vacherie, La., etc., and Lake des Allemands, bayous Chevreuil and Tigre between	229		1841			
Vallette Dry Dock, removal of wreck of	231		1869			
Van Buren, Mo., Current River below, examination of	257			2065		
Vancouver, Wash., and mouth of Willamette River, Oregon, Columbia River between, examination and survey of	421					
Vancouver, Wash., bridging Columbia River near	429					
Vermillion, Bayou, bay and passes, La., examination of	230		1855			
Vermillion Harbor, Ohio, improvement of	368				2847	
Vidal, Bayou, La., improvement of	242			1992		
Vienna, Ala., and Fulton, Miss., Tombigbee River between, improvement of	213		1780			
Vienna, Ala., Tombigbee River below, improvement of	214		1781			
Vincennes, Ind., Wabash River above, improvement of	297			2407		
Vincennes, Ind., Wabash River below, improvement of	297			2402		
Vineyard Haven Harbor, Mass., improvement of	50	700				
Volusia Bar, Fla., improvement of	187		1627			
W.						
Wabash River, Ind. and Ill., above Vincennes, improvement of	297			2407		
Wabash River, Ind. and Ill., below Vincennes, improvement of	297			2402		
Wabash River, Ind. and Ill., improvement of	297			2402		
Wabash River, Ind., between Terre Haute and Lafayette, examination of	298			2411		
Waccamaw River, to Waccamaw Lake, N. C. and S. C., improvement of	170		1442			
Waco, Tex., Brazos River below, examination of	235					
Walker Bridge and Fulton, Miss., Tombigbee River between, improvement of	213		1779			
Wappinger Creek, N. Y., improvement of	84	885				
Wappoo Cut, S. C., improvement of	176		1477			
War maps, estimates for publication of	450					
Wareham Harbor, Mass., improvement of	50	701				
Warrior River, Ala., improvement of	212		1776			
Warsaw, Ill., Mississippi River at, examination of	264			2134		
Warwick River, Md., examination and survey of	132		1218			
Washington Aqueduct, maintenance and repair of	436					3875

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
Washington Bayou, Miss., improvement of..	244			2005		
Washington, D. C.:						
Construction of casemates at	6					
Defense of	5 7					
Examination and survey of Potomac River below	146					
Improvement and care of public buildings and grounds	444					3907
Improvement of Potomac River at	135	1246				
Increasing water supply of	442					3904
Maintenance and repair of Washington Aqueduct.....	436					3875
Maintenance of Washington Monument	444					3907
Water supply of	441					3897
Washington Harbor, Pamlico River, N. C., examination of.....	170	1429				
Washington, Lake, Wash., ship canal to connect Puget Sound with, examination for	412					
Washington Monument, Washington, D. C., maintenance of.....	444					3907
Watch Hill Cove, Little Narragansett Bay, R. I., examination of	62 735					
Water gauges on Columbia River, Oregon and Wash.....	419				3372	
Water gauges on Mississippi River and its principal tributaries.....	246			2014		
Water gauges on Mississippi River at or near St. Paul, Minn	273			2214		
Water supply, District of Columbia.....	441					3897
Water supply of Washington, D. C., increasing	442					3904
Wateree River, S. C., between Camden and Falls of the Catawba, and bend about 4 miles below Camden, examination of.....	179	1487				
Wateree River, S. C., improvement of.....	174	1462				
Waterville to Augusta, Me., Kennebec River from, examination and survey of.....	33					
Water ways:						
Between Beaufort Harbor and New River, N. C., improvement of.....	162	1372				
Between Cape May and Great Bay north of Atlantic City, N. J., examination of.	118	1097				
Between Chincoteague Bay, Va., and Delaware Bay, at or near Lewes, Del., improvement of.....	123	1168				
Between Doboy and Sapelo, Ga., examination and survey of.....	185					
Between Jamaica Bay and Long Beach Inlet, N. Y., examination and survey of	94					
Between Jefferson, Tex., and Shreveport, La., and Cypress Bayou, survey of...	248			2021		
Between Lynn Haven Bay and Eastern Branch of Elizabeth River, Va., examination of.....	153	1310				
Between New Berne and Beaufort, N. C., improvement of	160	1363				
Between New River and Swansboro, N. C., improvement of.....	162	1376				
Between Norfolk Harbor, Va., and Albemarle Sound, N. C., improvement of.	151	1302				
Between Pamlico River and Bay River, N. C., examination of.....	170	1421				
Between Port Townsend Bay and Oak Bay, Puget Sound, Wash., examination for	409				3260	
Between Pungo River and Sladesville, N. C., examination of.....	170	1418				
Between Savannah, Ga., and Fernandina, Fla., examination and survey of.	185					
Connecting Lakes Union, Washington, and Samamish with Puget Sound, Wash., examination for.....	412					
In connecting waters of the Great Lakes, between Chicago, Duluth, and Buffalo, examination of	362					2810
Near Coaster Harbor Island, R. I., improvement of.....	57 718					
Waukegan Harbor, Ill., improvement of....	327			2568		
Wellfleet Harbor, Mass., improvement of...	44 663					
West Bay, West Galveston Bay, Tex., channel through, examination and survey of.....	235					

Subject.	Page.					
	Part I.	Part II.	Part III.	Part IV.	Part V.	Part VI.
West Galveston Bay, Tex., from Christians Point, for reopening channel through West Bay, examination and survey of....	235					
West Liberty, Ky., and Farmer, Licking River between, improvement of	306			2462		
West Neck River, Va., examination of	153	1324				
West Point, Ga., and Franklin, Ala., Chattahoochee River between, examination of.	211		1756			
Westchester Creek, N. Y., examination and survey of.....	94 954					
Western branch of Elizabeth River, Va., examination of.....	153	1307				
Weston, Mo., Missouri River at, examination of.....	275			2229		
Westport Harbor, Mass., improvement of ..	52 706					
Wetumpka, Ala.. Alabama River up to, examination of	211		1761			
Wetumpka, Ala., and East Tennessee, Virginia and Georgia Railroad bridge, Coosa River between, improvement of.....	208		1748			
Weybosset (schooner), removal of wreck of.	61 731					
Weymouth Back River, Mass., examination and survey of.....	47 682					
Weymouth River, Mass., improvement of ..	42 655					
White Oak River, N. C., between Roberts Landing and Collins Crossing, examination of.....	170	1434				
White River, Ark., improvement of	252			2048		
White River, Ark.(Lower), examination and survey of	257					
White River Harbor, Mich., improvement of.	339					2687
White River, Ind., improvement of	298			2409		
Whitehouse, Josiah (schooner), removal of wreck of.....	61 732					
Wicomico (Great) River, Va., examination of.	146	1288				
Wicomico River, Md., improvement of	128	1193				
Wicomico River, Newport Creek at head of, Md., examination of.....	146	1281				
Willamette River, Oregon:						
Examination and survey of, at Clackamas Rapids, Ross Island, and Corvallis	421					
Examination and survey of, below Portland	421					
Examination and survey of Columbia River between Vancouver, Wash., and mouth of	421					
Examination of, on west side of Swan Island	420					3373
Improvement of, above Portland.....	417					3368
Improvement of, below Portland.....	416					3362
Willapah River, Wash., below Woodward Landing, examination and survey of	409					3266
Willets Point, N. Y., post of	15 537					
Willow River, Wis., near Hudson, examination of	274			2218		
Willow Slough, Ill., reopening				2124		
Willsboro, N. Y., Boquet River below, examination of	388					2940
Wilmington Harbor, Cal., establishment of harbor lines at San Pedro.....	18 426					2976
Wilmington Harbor, Cal., improvement of ..	391					2956
Wilmington Harbor, Del., improvement of ..	119	1136				
Wilmington Harbor, Del., survey for improvement of	120	1138				
Wilmington, N. C., Cape Fear River above, improvement of.....	165	1390				
Wilmington, N. C., Cape Fear River at and below, improvement of	166	1394				
Wilson Creek, Va., and Greenbrier River, W. Va., New River between mouths of, improvement of.....	302			2430		
Wilson Harbor N. Y., improvement of.....	376					2891
Wilson Point Harbor, Conn., improvement of.	71 789					
Winfield, Richard M., *et al.*, bridge of, in Barnstable, Mass	431					
Winona and Southwestern Railway Company, bridge of, across Mississippi River at Winona, Minn	427					
Winona, Minn., bridge of city of, across Mississippi River	431					
Winona, Minn., bridging Mississippi River at.....	427 431					

Subject.	Page.						
	Part I.		Part II.	Part III.	Part IV.	Part V.	Part VI.
Winthrop Harbor, Mass., improvement of...	40	644					
Winyaw Bay, S. C., improvement of.....	169		1411				
Wisconsin River, Wis., improvement of.....	328				2572		
Wisconsin River, Wis., survey for reservoirs at sources of.....					2214		
Withlacoochee River, Fla., improvement of.	193			1659			
Woods Landing, Oregon, and Astoria, Columbia River between, examination for snagging.....	420					3380	
Woodward Landing, Wash., Willapah River below, examination and survey of..	409					3266	
Works, occupancy of and injury to public, by corporations or individuals.....	19	436					3865
Wrecks, removal of.....	17						
At Elizabethport, N. J., near entrance to Arthur Kill.....	107		1013				
At Pollock Rip Shoals, Mass.....	61	731					
In Barnegat Inlet, N. J	118		1090				
In Chesapeake Bay.....			1201				
In Columbia River near Astoria, Oregon.	420					3373	
In Delaware Bay	118		1090				
In Delaware Bay and River.....	118		1090				
In Hyannis Harbor, Mass.....	62	732					
In Jackson Creek, Chester River, Md ..	131		1201				
In New Orleans Harbor, La.....	231			1869			
In New York Harbor, N. Y	93	937					
In Ogeechee River, Ga.....				1605			
In Pamlico River, N. C., opposite Swan Point.....	169		1417				
In Pleasant River, Me	32	610					
In Portland Harbor, Me	32	609					
In Rancocas River, N. J.....			1090				
In Raritan Bay, N. J.....	93	937					
In St. Clair River, Mich.....	361					2801	
In Savannah River and Harbor, Ga.....	184			1602			
In Ship Island Harbor, Miss	228			1837			
In Smyrna River, Del.....	131		1201				
In South Channel across bar, Charleston Harbor, S. C	178		1487				
Near Gay Head Light	61	732					
Near Handkerchief Light-ship	61	731					
Wrightsville and Tennille (Tennville) Railroad Company, bridge of, across Oconee River, Ga	429						
Wyandotte County, Kans., bridging Missouri River at	432						
Y.							
Yadkin River, N. C., improvement of	167		1404				
Yamhill River, Oregon, below McMinnville, examination and survey of.....	421					3381	
Yaquina Bay, Oregon, improvement of	403					3182	
Yazoo River, Miss., improvement of.....	243				1996		
Yellow Banks, Chippewa River, Wis., improvement of.....	270				2201		
Yellow River, Ga., from bridge near Covington to Ocmulgee River, examination of	184			1606			
Yellowstone National Park, construction and improvement of roads and bridges in..	447						3931
Yellowstone River, Mont. and N. Dak., improvement of	276				2236		
Yellowstone River, Mont., below mouth of Tongue River, examination of	277				2239		
York Harbor, Me., improvement of.	29	602					
York River, Va., improvement of	143		1270				
Youghiogheny River, Pa., at McKeesport, bridging.....	431						
Youngs Bay, Oregon, channel in, examination of.....	420					3376	
Youngs River, Wash., improvement of.....	419					3371	
Yuma, Ariz., and Eldorado Cañon, Colorado River between, examination of	393					2974	
Z.							
Zanesville, Ohio, bridge obstructing canal of Muskingum River at foot of Main street..	434						

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